THE GREAT PYRAMID

ITS DIVINE MESSAGE

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AN ORIGINAL CO-ORDINATION OF HISTORICAL DOCUMENTS AND ARCHÆOLOGICAL EVIDENCES

BY

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PREFACE TO THE SEVENTH EDITION

THE claim that the Great Pyramid enshrines a Divine Revelation has been fully vindicated on the bases laid down in the first edition of this work. This has been proved to demonstration in successive works, papers and articles [1] by the present writer during the twelve years that have elapsed since the first edition appeared. Recent developments in interpretation, in our knowledge concerning the Great Pyramid's design and construction, and in our experience of the current fulfilment of the Great Pyramid's prophecy, are fully dealt with in *The Great Pyramid's Prophecy concerning the British Empire and America* (Sept. 1932); *The Date of the Crucifixion and the Era of New Birth* (Revised 3rd Edition, May 1934); and *The Hidden Truth in Myth and Ritual and in the Common Culture Pattern of Ancient Metrology* (Sept. 1934). These later developments entirely confirm what the present work establishes as the intention of the Great Pyramid's design and the purpose of its construction. It has therefore been considered inadvisable to depart from the plan adopted in the successive editions, namely, to leave the text and plates substantially as these stand in the first edition, except for the few minor corrections continual reference has shown to be necessary. In the present edition, as in the sixth edition, the long Introduction and the prefaces to the first five editions, together with certain reprinted papers which appeared between the prefaces and the Table of Contents, in the second to fifth editions, are omitted. Certain annotations to Plates X, XVI, XVII, XVIII and XX are also omitted. The matters with which all of these dealt are either now too well known to require reiteration or are more fully dealt with in the works above mentioned.

The questions dealt with on pages 434 to 436 concerning the date of the Great Pyramid's construction and early Egyptian chronology have been definitely settled by the analytical investigation undertaken in "Early Egypt, Babylonia and Central Asia" (1927), which completes and confirms the historical study of the present work. The correlated data of the latter work show that the First Egyptian Dynasty began in 3101 B.C., and that the Great Pyramid was built during the reign of Khufu, 2645 B.C. to 2622 B.C.

Here it must be emphasized that the geometrical representation of the Great Pyramid is expressed in Pyramid inches, the Pyramid inch being identical in value with Sir John Herschel's "geometrical inch," which is 1.0011 British inch. This Pyramid inch is also the basal unit of the geometrical

[1] A full list of these additional publications is given on pages xii and xiii.

system of the common culture pattern of ancient metrology. The continued blindness of Egyptological and other authorities in this relation is inexplicable. Authentic proof, however, of ancient Egyptian knowledge of the Pyramid inch and of the basis of the common culture pattern of metrology is given in the Egyptian King Lists, wherein fundamental measurements (expressed in the Great Pyramid in Pyramid inches) are stated as periods of years, thus proving that the ancient Egyptians knew of the symbolical association of these measurements with a chronological representation of outstanding significance (refer to Plate XVI of the present work). This is an absolute identity which no critical opponent has yet had the temerity to discuss.

When Sir Flinders Petrie's fundamental measurements of the Great Pyramid are converted into Pyramid inches and are compared with the geometrical pattern and the structural theme of Displacement (hereafter referred to), the fundamental structural measurements correspond precisely with dynastic periods given in the King Lists. That this identity does not depend upon the metrological culture pattern (cf. *The Hidden Truth in Myth and Ritual*, Part 2), but is confirmatory of the independent identity established by the latter, is a demonstrable fact, the significance of which scholars must elucidate for themselves. When they have done so they will find that no confirmation from any ancient source could be more *conclusive* regarding the authenticity of the Pyramid inch and its function, or more *enlightening* concerning the purpose of the fabrication and falsification of the ancient Egyptian King Lists. They will find that the falsification of the Lists was made to give the appearance of truth to the perversion of the earliest Messianic prophecies, which centred upon the structural allegory of the Great Pyramid, and that the motive behind that perversion was to "justify" the substitution of Osiris and other pagan deities of pre-Pyramid ages for the long-promised Saviour of the world.

The essential theme of the present work is the Great Pyramid's structural allegory of the *symbolical builders' Error of Displacement*, whereby the apex-stone or "head stone of the corner" was "rejected." The displacement value in this structural allegory is 286.1 Pyramid inches and the principal application of this value is to the Pyramid's exterior. The application resulted in a hollowing-in of the Pyramid's core-escarpments, in the form shown diagrammatically on Plate XVIII, to receive a like hollowing-in of the casing. The air-photograph reproduced on page x confirms the existence of this feature of the core-escarpments, and the Egyptian Government Survey of the Great Pyramid, in 1925, confirms the previously established Displacement Value, thus conclusively disposing of the doubts expressed on these points by Egyptological authorities and of certain ill-informed criticism which has arisen from other quarters. Any technical authority, therefore, who wishes to study the later data in correlation with the data dealt with in the present work is referred to pages 50 to 57 of *The Hidden Truth in Myth and Ritual*. Reference will show that the structural allegory of the Great

Pyramid was more truly monumentalized in the Great Pyramid than the writer knew during the preparation of the first edition of this work in 1923. The structural allegory is epitomised in diagrammatical form on page xi following.

Indeed, every fact which has come to light since the first edition was published has strengthened the conviction that the present work must stand substantially as it was in the first edition, so that it may remain as a record of the writer's fundamental bases of interpretation. The work has stood the test of the most intensive period of rapid changes in world history, a period which has proved all authorities vulnerable, all man-made sociological systems wrong, and every cult in error. Such changes were foreshown in the present work, and the reason for such changes were explained, not because the writer foresaw them but because they were Divinely revealed by the Great Pyramid's prophecy.

In the Introduction to the fourth edition (October 1927), by an independent writer, it was stated as follows:—

> ". . . . . Criticism (devoted to isolated matters of detail within the province of the particular expert involved and without consideration of the authors' conclusions as a whole) can neither overthrow nor establish the authors' main conclusions. If, as the authors maintain, a Divine Revelation has been given concerning the events which lead up to, and the actual period of, the final tribulation, and the coming of the Messianic Kingdom, it is manifestly impossible that man should have precise knowledge of these events. This would defeat the Divine Purpose. If, when the history of the critical years (before the date indicated for the end of the final period of Chaos and Oppression) is considered as a whole and in its relation to the fiducial dates given by the authors' scale of chronology, it is seen that the Divine purpose is working in accordance with the indications contained in this book, then the conditions of the test will have been fulfilled, *and the message of the Pyramid delivered.*"

The Pyramid's prophecy revealed that a period of Tribulation on the British world order should extend from May 29, 1928, to September 16, 1936, as a consequence of production exceeding the means of world power to control production and to organise the distribution of production (*cf.* pp. 398–400, and references to preceding paragraphs). The writer has since shown, by references to reliable authorities and statistics, that the "Battle of the Gold Standard" began intensively from May 29, 1928; that French financial policy was re-oriented from that date; that Commodity Prices began to fall (on the London Market) from that date—falling 10 per cent. in a year, 20 per cent. in two years, and 34 per cent. in three years; and that the situation was immediately reflected by the New York rate of exchange for the pound sterling, which reached its highest value for 1928 on May 30, 1928, falling from that peak value and remaining below par until America was in turn overtaken by the world economic crisis.

By the second half of 1929 the rot which had undermined Commodity Markets had extended to the industrial part of the world structure, with the result that world trade rapidly shrunk, both in volume and value, until in 1934 and 1935 world trade has stood at a third of the value it registered in 1929. The rapid sequence of financial and economic changes brought disaster to the British Labour Government on August 23, 1931, and subsequently forced the pound sterling off the gold standard basis. The event, its causes, precise date, and consequences were foreshown from prophecy in two articles published in *The Morning Post*, July 17th and 18th, 1930, thirteen months before the event. The significance of the prophetic indications was reiterated in an article published in *The National Message*, July 11th, 1931. In these two series of articles (July 1930 and July 1931) it was shown that the prophetic indications revealed that the power to exercise "the world-function of protective and punitive sea-power" should be temporarily withdrawn from the English-speaking peoples, as "God's controlled forces of armament employed against the forces of destruction"; that new Power, on a higher spiritual basis, should thereafter be given them; that the new Power should quicken in its application onwards from December 5, 1935; and that between September 16, 1936, and August 20, 1953, the English-speaking peoples should be guided, as the nucleus of the Theocratic (or Theocentric) World-State, to receive Divine Protection ensuring racial isolation and true safe-guarding under the Law of the Kingdom of Heaven on earth.

Reference to the articles mentioned and to the other works and articles listed on pages xii and xiii—particularly to the articles in *The Morning Post*, October 1927, May 1928, and September and October 1929—will prove conclusively to the unbiassed reader that the Great Pyramid's Divinely revealed prophecy has been fulfilled to date in details of time and circumstance. People forget that their outlook has changed considerably during the past ten years. But the Great Pyramid's predictive outlook, presented eleven years ago, has not been changed. Clerics, scientists, journalists, publicists, and statesmen—and even some dictators—are now proclaiming, concerning current times and the immediate future, things which were revealed ten years ago by the Great Pyramid's prophecy, but which were scorned and ridiculed and rejected at the time. In other words, none of the authorities, who are now proclaiming these things, would admit their possibility ten years ago. Now that they do proclaim them, they forget that they refused to believe their possibility when such things were foreshown from prophecy. Even now they refuse to believe that any kind of Revelation from the Almighty is possible other than is projected, as they suppose, through their own purblind and self-satisfied intellects.

In refusing thoroughly to investigate the evidence, and the logical conclusions and confirmations submitted, and by thereby impeding the general acceptance of the Great Pyramid's Scientific Revelation—"THE WITNESS UNTO THE LORD OF HOSTS" (Isa. xix, 19, 20)—which testifies,

inter alia, that Jesus Christ is the TRUTH and is before all things and that by Him were all things created, scholars have unwittingly obstructed the deliverance of the Greatest Message which could possibly be given to mankind in these troublous days and have thus displayed the mentality and conservatism of their predecessors of nineteen centuries ago.

I owe a debt of gratitude to my late colleague, Dr. H. Aldersmith—who died before our researches were completed and before the writing of the present work began—for his able guidance in elucidating and interpreting the symbolism of Biblical prophecy.

I must also express my profound gratitude to Mr. C. V. Stephens for his appreciation and generosity in making publication possible, and for his invaluable advice and suggestion concerning the organisation of the work.

Since I came into touch with Mr. Stephens, more than fifteen years ago, the vital essentials of the presentation, in this and all subsequent works and articles, have developed in a manner altogether surprising to me, and I must acknowledge that it is chiefly due to his initiative, advice, and decision that the work has been presented in a form that far exceeds anything my late colleague and myself had ever hoped for.

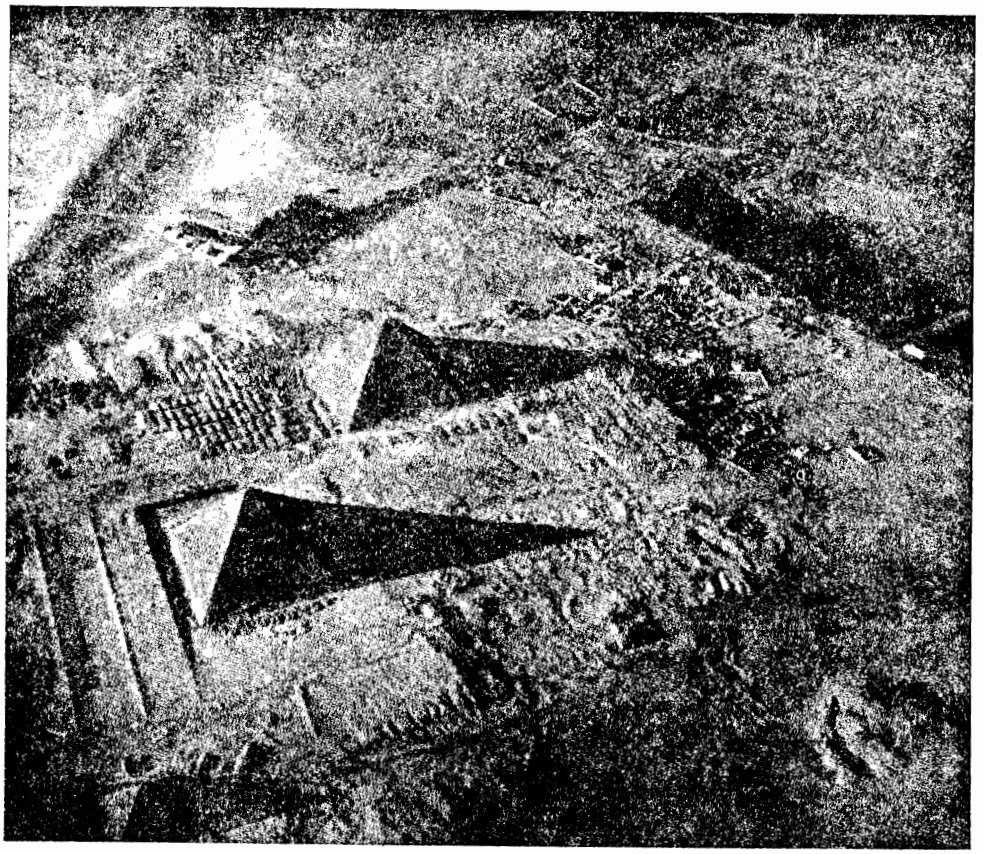
D. DAVIDSON.

2nd April 1937.

ADDENDUM

In view of recent ill-informed articles in the Press on the Great Pyramid's prophecy, it is necessary to reiterate that there are no grounds for the interpretation that after September 16, 1936, there will be no more war. The King's Chamber period, from September 16, 1936, to August 20, 1953, is defined as the period of the Judgment of the Nations, of the Unveiling of "The Mystery of the Open Tomb" and of the return to the Plane of the Divine Centre. It is also defined as the period during which the nations of the New World order, of which the English-speaking peoples form the nucleus, are brought safely through the dangers and difficulties which beset them; and as the period during which the forces of war and disorder will be ultimately subdued by Divine Intervention.

D. D.

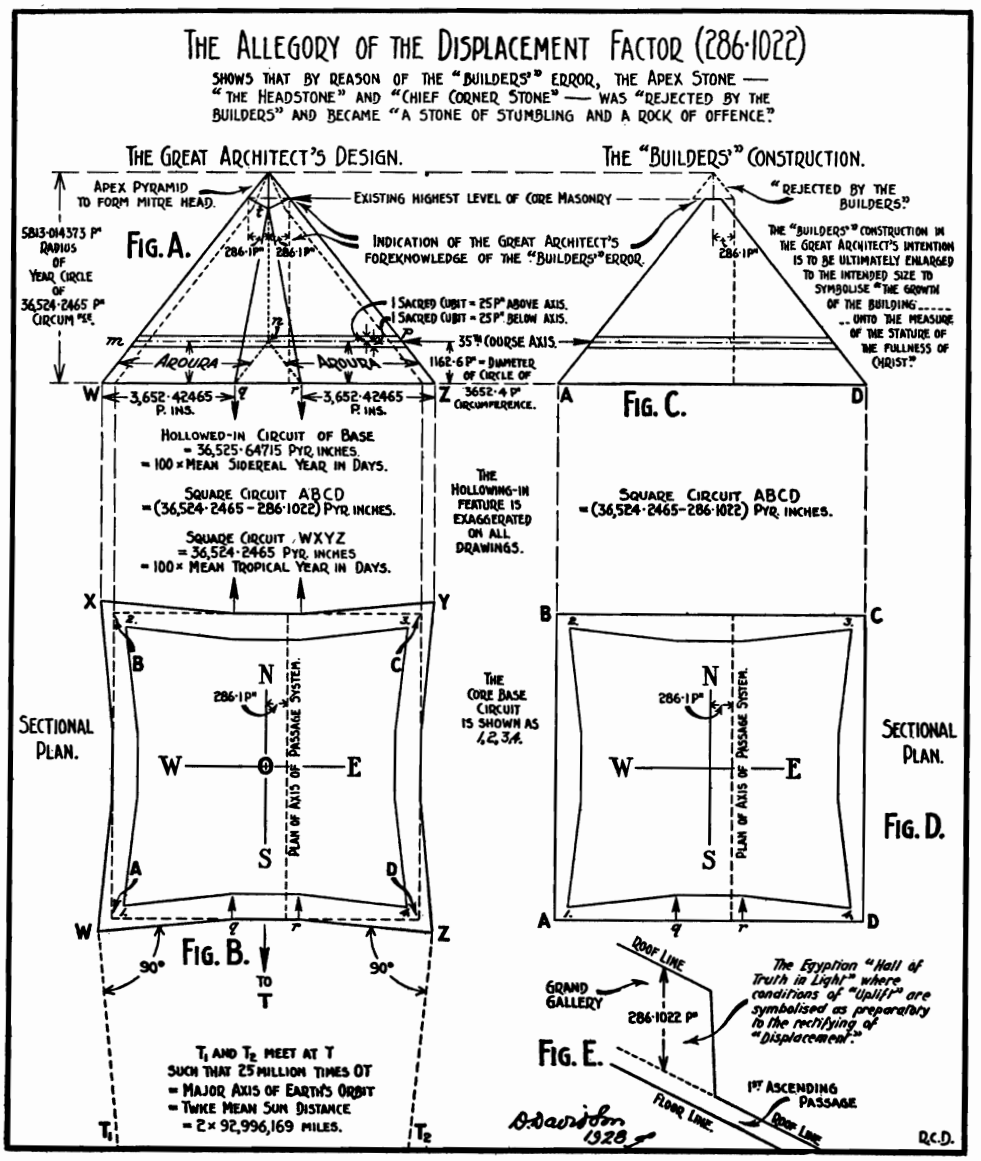


A UNIQUE AIR-PHOTOGRAPH OF THE PYRAMIDS OF GIZEH.

SETTLING A CONTROVERSY OF LONG STANDING, AND REVEALING A STRUCTURAL FEATURE OF THE GREAT PYRAMID, THAT IS THE KEY TO THE UNRAVELLING OF ALL ITS MYSTERIES AND THAT HAS REMAINED UNOBSERVED FOR NEARLY 5000 YEARS.

The reproduction is from an air-photograph by Brigadier-General P. R. C. Groves, C.B., C.M.G., D.S.O., by whose kind permission the reproduction appears. The photograph was taken before sunset from an elevation of 4000 feet. Only two of the four slopes of each of the three greater pyramids of Gizeh appear. The west slope of each pyramid is shown reflecting the light from the setting sun, and the south slope of each pyramid in shadow. The Third Pyramid is partly shown in the bottom left-hand corner of the photograph, the Second Pyramid lies behind, and the Great Pyramid is farthest removed.

The casing stones of the original smooth sloping surfaces of the Great Pyramid were removed eleven centuries ago. The "slopes" shown are therefore the stepped escarpments that were exposed when the casing stones were removed. The south stepped "slope" of the Great Pyramid reveals, on the photograph, a structural feature that does not appear on the other two pyramids. This is a shallow V-shaped depression of the surface of the stepped "slope." This depression, or hollowing-in, occurs on all four stepped "slopes" of the Great Pyramid, but, so far as is known, does not occur on any other pyramid. The V-shaped depression is shown very clearly by the difference in tone of the shadows on the two halves of the south stepped "slope." There is a clear line of demarcation on the original photograph between the two tones of shade, down the centre of the escarpment. The darker tone is seen on the left half of the triangle forming the south stepped "slope."



THE GREAT ARCHITECT'S ALLEGORY OF THE BUILDERS' ERROR.

The interpretation, in 1924, disclosed that every allegorical element of Displacement, throughout the Pyramid's structure, was indicated by a constant measure of 286.1022 Pyr. inches, termed the Great Pyramid's Displacement Factor. The designed square base circuit for the Perfect Structure (Figs. A and B above) was inferred as measuring 36,524.2 Pyramid inches (symbolising the value of the solar year to the scale of 100 Pyramid inches to a day). The Egyptian Government Survey (1925) later showed that the square base circuit of the Pyramid as actually built (Figs. C and D above) was 286.1022 Pyr. inches (the Displacement Factor) short of the perfect base square circuit of 36,524.2 Pyr. inches. The designed intention for the form of the finished casing slopes is proved by the built form of the stepped core escarpments hollowed in as shown on the air-photograph on the preceding page. To indicate the imperfect nature of the built structure the apex-stone was not placed on the Pyramid. Confirming this fact Diodorus states that in his day (60 B.C.) the casing of the Great Pyramid was "entire and without the least decay" and yet lacked its apex stone. This omission of the apex stone is an essential part of the structural allegory delineated in the present work.

A LIST OF OTHER
WORKS, PAPERS AND ARTICLES BY D. DAVIDSON.

THE SCIENCE OF THE PYRAMID'S REVELATION . . .	March, 1925.
Revised edition	June, 1926.
THE ORBIT OF MESSIANIC CIVILISATION AND OUR LORD'S LIFE	March, 1925.
Revised edition	June, 1926.
PYRAMID PROPHECY AND CURRENT EVENTS	July, 1925.
Revised edition	Nov., 1925.
EARLY EGYPT, BABYLONIA AND CENTRAL ASIA: A CONNECTED HISTORY	1927.
THE GREAT PYRAMID'S PROPHECY ON THE CURRENT ECONOMIC OPPRESSION	March, 1931.
THE GREAT PYRAMID'S PROPHECY CONCERNING THE BRITISH EMPIRE AND AMERICA	Sept., 1932.
THE EXODUS OF ISRAEL: ITS DATE AND HISTORICAL SETTING	Nov., 1933.
THE DATE OF THE CRUCIFIXION AND THE ERA OF NEW BIRTH	Dec., 1933.
Revised edition	May, 1934.
THE HIDDEN TRUTH IN MYTH AND RITUAL, AND IN THE COMMON CULTURE PATTERN OF ANCIENT METROLOGY .	Sept., 1934.
HERSCHEL'S GEOMETRICAL INCH	June, 1938.
NEBUCHADNEZZAR'S SIEGE OF JERUSALEM	Sept., 1938.
THE DOMINATION OF BABYLON: LITERAL AND SYMBOLIC. .	Feb., 1939.

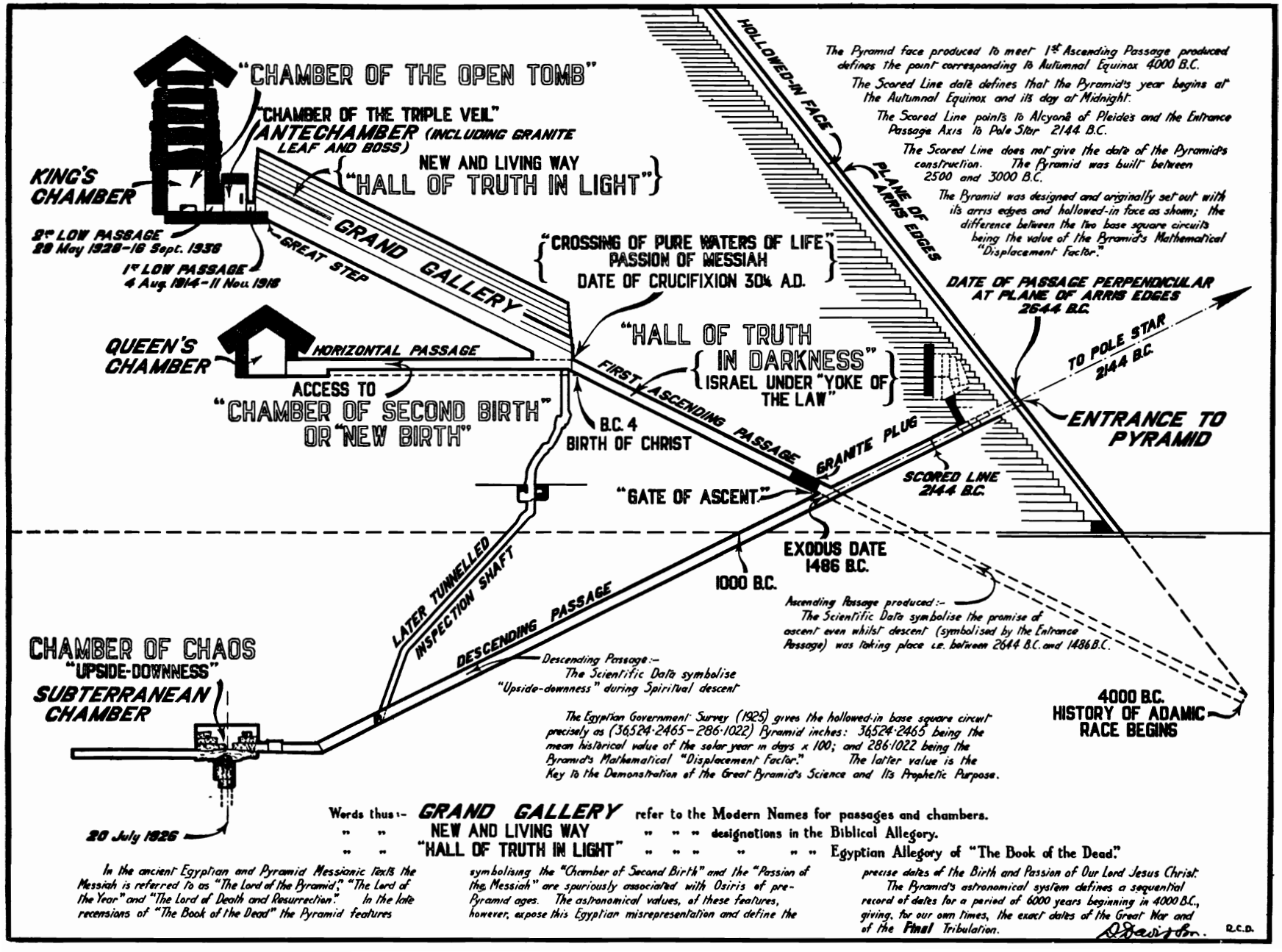
Papers read before *The Institution of Structural Engineers.*

THE STRUCTURAL ASPECT OF THE GREAT PYRAMID.
Published in *The Structural Engineer*, July and August, 1929.

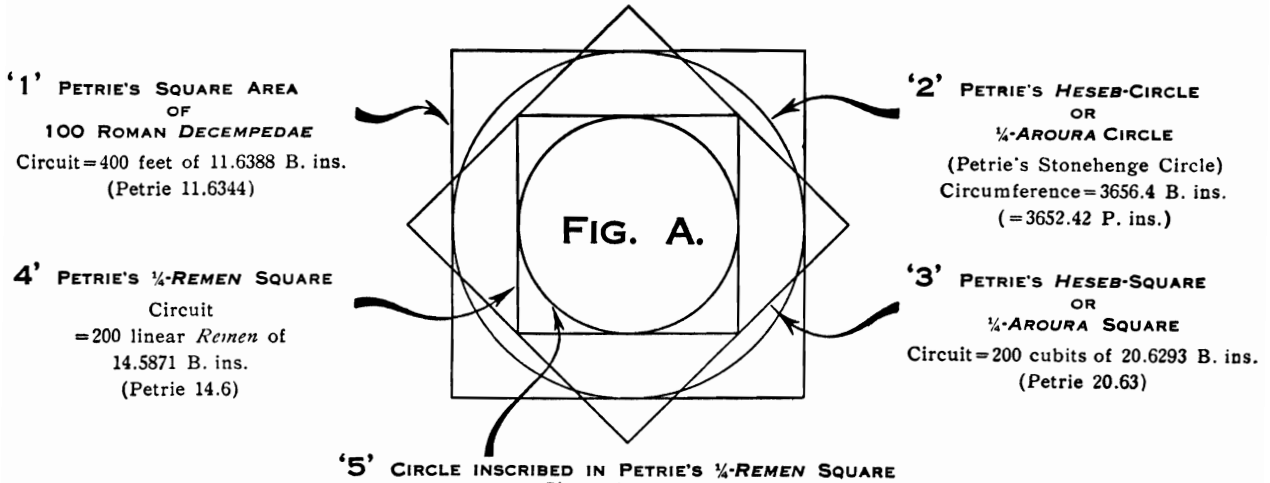
PYRAMID BUILDING PROBLEMS: MAN-POWER ORGANISATION IN THE PYRAMID AGE:—An Analysis demonstrating how the Great Pyramid was built.
Published in *The Structural Engineer*, March and April, 1930.

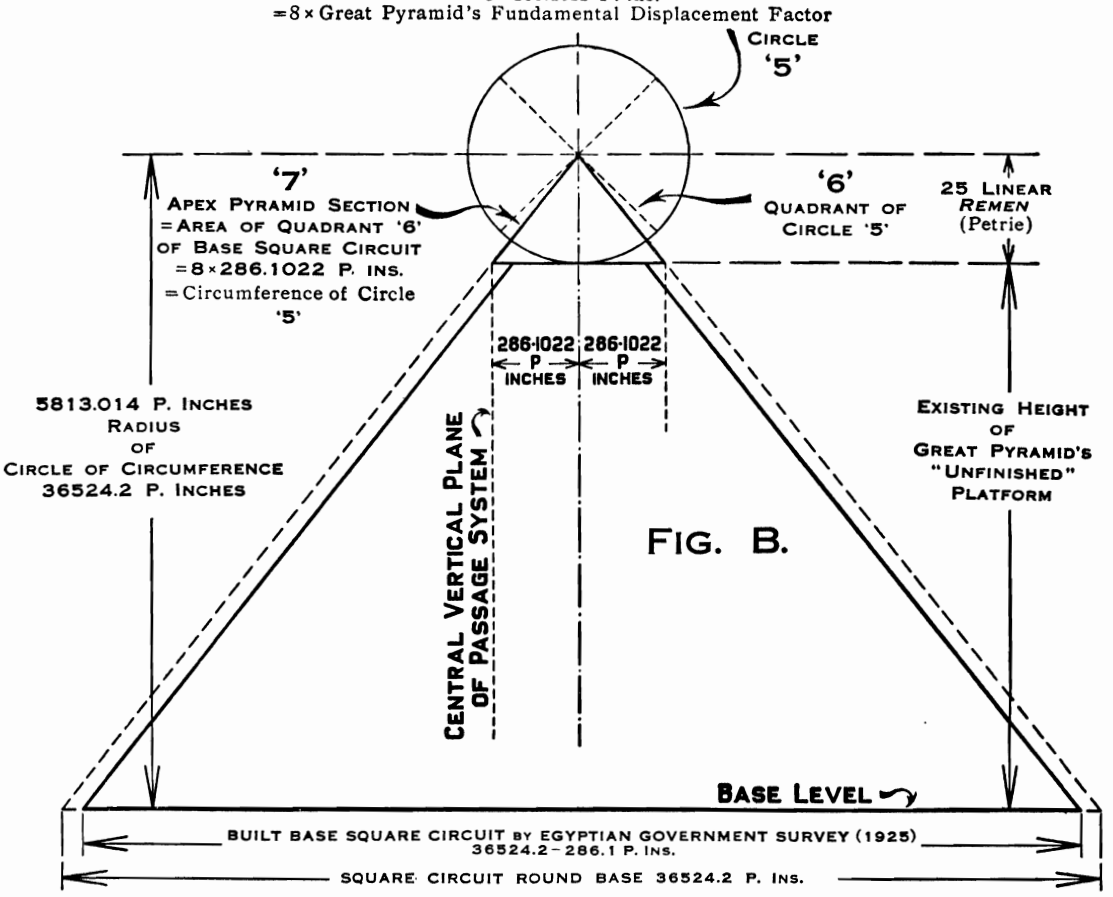
Special Articles published in *The Morning Post.*

ISRAEL IN EGYPT AND THE EXODUS . . .	Oct. 7th and 8th, 1926.
THE GREAT PYRAMID . . . . . (Royal Albert Hall Address.)	March 3rd, 1927.
PROPHECY AND THE GREAT PYRAMID . . .	Oct. 17th, 21st, 22nd, and 24th, 1927.
THE GREAT PYRAMID'S SCIENTIFIC REVELATION .	May 16th, 17th, 18th, 19th, 21st, 22nd, 23rd, and 24th, 1928.
THE GREAT PYRAMID'S PROPHECY AND ITS FULFILMENT. "Tribulation Beginning" . . .	Sept. 25th, 1928.
THE GREAT PYRAMID'S PROPHECY AND ITS FULFILMENT. "The Battle of the Gold Standard" .	Sept. 28th, 30th, and Oct. 1st, 1929.
CHURCH AND STATE IN THE GREAT PYRAMID'S PROPHECY	July 17th and 18th, 1930.
THREE GREAT REVELATIONS	Oct. 9th, 1931.
GREAT PYRAMID FUNDAMENTALS	Oct. 7th, 1932.
NEW LIGHT ON THE EXODUS	Oct. 6th, 1933.
THE GREAT PYRAMID'S MESSAGE TO THE WORLD TO-DAY	Oct. 5th, 1934.
THE GREAT PYRAMID: "The Witness Unto the Lord of Hosts"	Nov. 16th, 1935.


"CHAMBER OF THE OPEN TOMB"
"CHAMBER OF THE TRIPLE VEIL"
ANTECHAMBER (INCLUDING GRANITE LEAF AND BOSS)
NEW AND LIVING WAY
"HALL OF TRUTH IN LIGHT"
KING'S CHAMBER
2nd LOW PASSAGE
28 May 1928–16 Sept. 1936
1st LOW PASSAGE
4 Aug. 1914–11 Nov. 1918
GREAT STEP
GRAND GALLERY
"CROSSING OF PURE WATERS OF LIFE"
PASSION OF MESSIAH
DATE OF CRUCIFIXION 30¼ A.D.
HOLLOWED-IN FACE
PLANE OF ARRIS EDGES
The Pyramid face produced to meet 1st Ascending Passage produced defines the point corresponding to Autumnal Equinox 4000 B.C.
The Scored Line date defines that the Pyramid's year begins at the Autumnal Equinox and its day at Midnight.
The Scored Line points to Alcyone of Pleides and the Entrance Passage Axis to Pole Star 2144 B.C.
The Scored Line does not give the date of the Pyramid's construction. The Pyramid was built between 2500 and 3000 B.C.
The Pyramid was designed and originally set out with its arris edges and hollowed-in face as shown; the difference between the two base square circuits being the value of the Pyramid's Mathematical "Displacement Factor."
DATE OF PASSAGE PERPENDICULAR AT PLANE OF ARRIS EDGES 2644 B.C.
TO POLE STAR 2144 B.C.
QUEEN'S CHAMBER
HORIZONTAL PASSAGE
"HALL OF TRUTH IN DARKNESS"
ISRAEL UNDER "YOKE OF THE LAW"
FIRST ASCENDING PASSAGE
GRANITE PLUG
ENTRANCE TO PYRAMID
ACCESS TO "CHAMBER OF SECOND BIRTH" OR "NEW BIRTH"
B.C. 4 BIRTH OF CHRIST
SCORED LINE 2144 B.C.
"GATE OF ASCENT"
EXODUS DATE 1486 B.C.
1000 B.C.
LATER TUNNELLED INSPECTION SHAFT
DESCENDING PASSAGE
Ascending Passage produced:–
The Scientific Data symbolise the promise of ascent even whilst descent (symbolised by the Entrance Passage) was taking place i.e. between 2644 B.C. and 1486 B.C.
Descending Passage:–
The Scientific Data symbolise "Upside-downness" during Spiritual descent
CHAMBER OF CHAOS
"UPSIDE-DOWNNESS"
SUBTERRANEAN CHAMBER
4000 B.C.
HISTORY OF ADAMIC RACE BEGINS
20 July 1926
The Egyptian Government Survey (1925) gives the hollowed-in base square circuit precisely as (36524·2465 – 286·1022) Pyramid inches: 36524·2465 being the mean historical value of the solar year in days x 100; and 286·1022 being the Pyramid's Mathematical "Displacement Factor." The latter value is the Key to the Demonstration of the Great Pyramid's Science and its Prophetic Purpose.
Words thus:– GRAND GALLERY refer to the Modern Names for passages and chambers.
" " NEW AND LIVING WAY " " " designations in the Biblical Allegory.
" " "HALL OF TRUTH IN LIGHT" " " " " " " Egyptian Allegory of "The Book of the Dead."
In the ancient Egyptian and Pyramid Messianic texts the Messiah is referred to as "The Lord of the Pyramid," "The Lord of the Year" and "The Lord of Death and Resurrection." In the late recensions of "The Book of the Dead" the Pyramid features symbolising the "Chamber of Second Birth" and the "Passion of the Messiah" are spuriously associated with Osiris of pre-Pyramid ages. The astronomical values, of these features, however, expose this Egyptian misrepresentation and define the precise dates of the Birth and Passion of Our Lord Jesus Christ.
The Pyramid's astronomical system defines a sequential record of dates for a period of 6000 years beginning in 4000 B.C., giving, for our own times, the exact dates of the Great War and of the Final Tribulation.
D. Davidson. R.C.D.

THE RELATIONSHIP BETWEEN THE METROLOGICAL "CULTURE PATTERN" AND THE GREAT PYRAMID'S DISPLACEMENT FACTOR

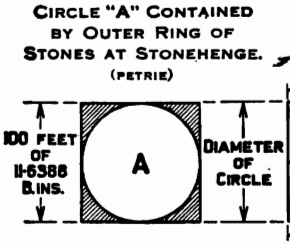




In the Great Pyramid's structural allegory the Apex Pyramid "7" symbolises "the measure of the stature of the fulness of Christ," for the gauging or "testing" or "proving" of the Perfect Structure, symbolised by the Pyramid of base square circuit 36,524.2 P. inches.

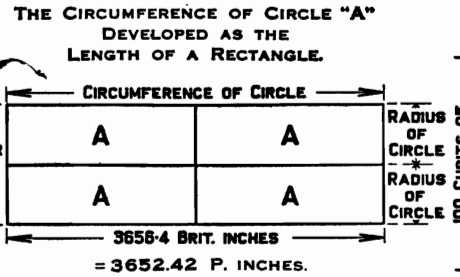
"The stone which the builders refused is become the headstone of the corner. This is the Lord's doing; it is marvellous in our eyes. This is the day which the Lord hath made . . . ."—*Psalm* cxviii, 22–24.

THE COMMON "CULTURE PATTERN" IN ANCIENT MEASURES.



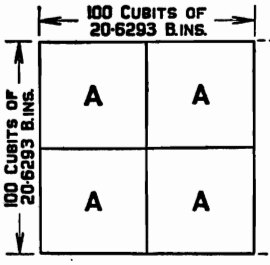
THE EGYPTIAN *HESEB* OR ¼-*AROURA* CIRCLE CONTAINED WITHIN SQUARE AREA OF 100 ROMAN DECEMPEDAE. 9407 SQUARE FEET (BRITISH) (PETRIE 9400 SQUARE FEET)

FIG. 1.



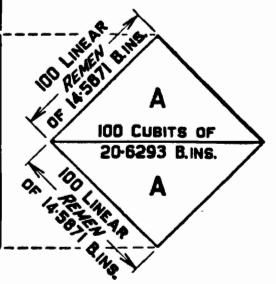
THE EGYPTIAN RECTANGULAR *AROURA*. EACH ¼-*AROURA* "A" IS ½-CIRCUMFERENCE OF CIRCLE "A" BY RADIUS OF CIRCLE "A".

FIG. 2.



THE EGYPTIAN *SETHĂT* OR SQUARE *AROURA*. (PETRIE)

FIG. 3.



THE EGYPTIAN SQUARE *REMEN* OR ½-*AROURA*. (PETRIE)

FIG. 4.

ALL CLEAR AREAS MARKED "A" ARE EQUAL IN AREA BEING EACH ONE *HESEB* OR ¼-*AROURA* (ANCIENT EGYPTIAN).

Circumference, 3656.4 B. inches, of Circle A contains 5000 digits of 0.73128 B. inch (Petrie, Rome, Assyria 0.730).
Diameter, 1163.88 B. inches, of Circle A contains 1600 digits of 0.72742 B. inch (Petrie, Egypt 0.7274).

Mean digit = 0.72935 B. inch
Side of Remen, 1458.71 B. inches contains 2000 digits of 0.72935 B. inch } *(Petrie, 0.729).*

Circumference, 3656.4 B. inches, of Circle A contains 200 circumferential cubits of 18.2822 B. inches
Diameter, 1163.88 B. inches, of Circle A contains 64 diametric cubits of 18.1856 B. inches

Mean cubit = Mean Mediterranean cubit of metrologists = 18.2339 B. inches
Side of Remen, 1458.71 B. inches contains 80 cubits of 18.2339 B. inches } *(Petrie, 18.23 to 18.24).*

SIR FLINDERS PETRIE'S STATEMENTS.

"Most ancient measures have been derived from one of two great systems, that of the cubit of 20.63 inches, or the digit of 0.729 inch; and both these systems are found in the earliest remains." (*Enc. Brit.*, 11th Ed., 1910, vol. 28, p. 482.)

"By having two systems, one the diagonal of the other (*cf.* Figs. 3 and 4 above), it was possible to denote one square half the area of the other." (*Enc. Brit.*, 14th Ed., 1929, vol. 15, p. 142.)

THE SIGNIFICANCE OF PETRIE'S STATEMENTS.

This means that there was but a single geometrical system, of which Figs. 1 to 4 above are completely definitive. *This fact was first discovered by the writer in* 1911, is referred to in correspondence with the late Dr. H. Aldersmith, between 1911 and 1914, and was published, with confirmatory data from many other sources, in 1924. The metrological data are discussed in Chapter II, and the geometrical basis of Petrie's *remen* is shown on Plates XXIII and XXIV of *The Great Pyramid: Its Divine Message* (July, 1924).

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APPENDIX I—THE EGYPTIAN KING LISTS.

TAILPIECES TO CHAPTERS

These are from the engravings of the drawings by Denon made during Napoleon's Egyptian Campaign, 1798–99.

TAILPIECE TO CHAPTER I.—View, at sunset, of the Island of Philæ, looking West. The island is now submerged by the impounded waters behind the Assouan Dam.

TAILPIECE TO CHAPTER II.—View of a small XVIIIth Dynasty peripteral temple on the Island of Elephantine. The temple was built by Amenhotep III and dedicated to the chief god of the 1st Cataract. It was destroyed by the Turkish governor in 1822. The temple shown is of interest as having been built during the early period of Semitic influence in the XVIIIth Dynasty, and as indicating a probable source for Greek architectural impulse (refer to Chapter V in this connection).

TAILPIECE TO CHAPTER III.—View of the Temple of Thoth at Hermopolis. Maspero states that " The portico was destroyed about 1820 by the engineers who constructed the sugar refinery at Rodah, and now only a few shapeless fragments of it remain."

TAILPIECE TO CHAPTER IV.—Another view of the Island of Philæ (North).

TAILPIECE TO CHAPTER V.—View of the 1st Cataract locality—looking South—with the Island of Elephantine shown in the foreground. This is now the site of the Assouan Dam.

My elucidation of the various phases of the Great Pyramid's design has led me to perceive that it is an expression of the Truth in structural form.

I proclaim, with humility and yet with confidence, that the Pyramid's Message establishes the Bible as the Inspired Word of God, and testifies that Jesus Christ, by HIS DISPLACEMENT, paid the purchase price of mankind's Redemption, and effected the Salvation of all who truly believe in Him.

This Message concerns all mankind, to whom, in a humble spirit, this work is dedicated, in the hope that it may bring enlightenment and comfort to many.

D. D.

CHAPTER I.

ANCIENT ASTRONOMICAL OBSERVATORIES, ALMANAC DEVICES AND TRADITIONS.

SECTION I.—GENERAL.

¶ 1. ANCIENT KNOWLEDGE CONCERNING THE SOLAR YEAR.

The Solar Year known in Earliest Times.

Its Two Ancient Forms.

It is evident that the civilised inhabitants of the Ancient East had precise knowledge of the duration of the Solar year. This is clear from every source of information, in archæology, literary tradition, and mythology, that is open to modern research.

Astronomical (Solstices and Equinoxes); Vegetation (Astronomical Seasons).

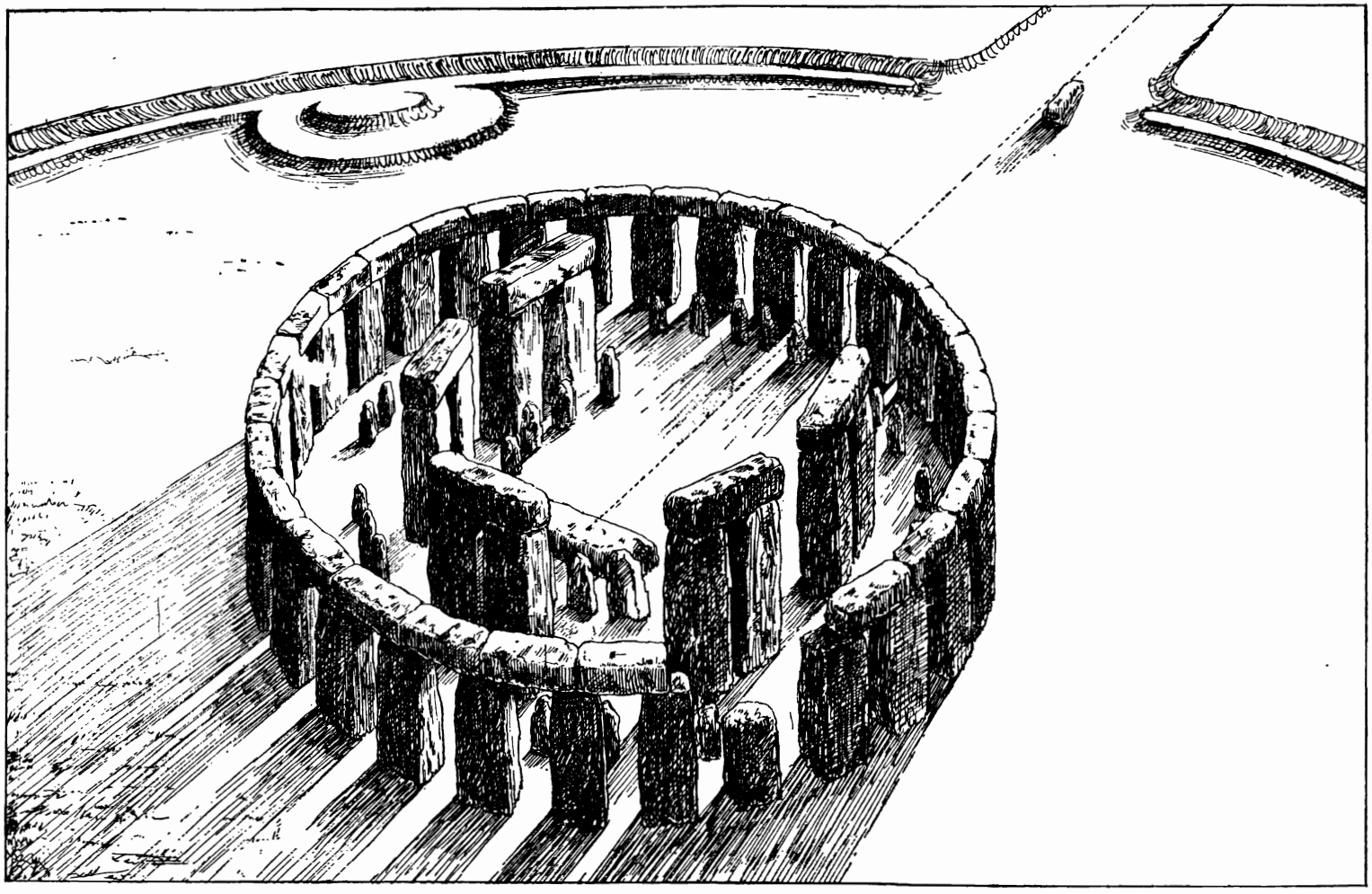
It was observed that the seasons were definitely fixed to the solar year, as defined by the astronomical phenomena accompanying the recurrence of the Solstices and Equinoxes.[1] From the knowledge of the recurrence of these, the four quarters of the agricultural year were observed to begin precisely mid-way between a Solstice and an Equinox.

The points of the Solar Astronomical Year and of the Solar Vegetation Year, as recognised in the earliest period of recorded ancient history are stated in terms of our modern (Gregorian) Calendar in Table I.

[1]Sir Norman Lockyer, "Dawn of Astronomy," pp. 12, 57, 62-66, 78-85, 89-93, 117-119, 244-245 (quotations from Ideler), 331 and 337.
Lockyer, "Stonehenge and Other British Stone Monuments," pp. 64-68, 96-106, 181-199, 308-315, 335 and 336.
The references are selected as, in our opinion, being free from elements that can be justifiably criticised on archæological grounds.
Prof. G. Forbes, "History of Astronomy," pp. 8-10.
W. G. Old, "The Chinese *Shu-King*," Introduction, Book I, Sect. I, and notes, Do. Sect. V, Book II, Sect. I, notes.
Encycl. Brit. (11th Edit.), Vol. I, pp. 224 and 317.

PLATE II.

PERSPECTIVE VIEW OF STONEHENGE AT TIME OF SUNRISE OF SUMMER SOLSTICE. 1680 B.C.



Drawn by A. C. de Jong

TABLE I.

THE TWO RECOGNISED FORMS OF SOLAR YEAR IN ANCIENT TIMES.

(STATED WITH REFERENCE TO MODERN CALENDAR YEAR FOR 1901 A.D.)

The Solar Astronomical Year.			*The Solar Vegetation Year.*
Early Semitic Astronomical Year began at AUTUMNAL EQUINOX	23 SEPT.		
WINTER BEGINS ..	MID-WAY ..	8 Nov.	Ancient November Agricultural Year began.
WINTER SOLSTICE ..	23 DEC.		
SPRING BEGINS ..	MID-WAY ..	4 FEB.	Chinese Agricultural Year began, (B.C. 2448).[1]
Later Semitic Astronomical Year began at VERNAL EQUINOX	21 MAR.		
SUMMER BEGINS ..	MID-WAY[2] ..	6 MAY	Ancient May Agricultural Year began.
SUMMER SOLSTICE ..	21 JUNE.		
AUTUMN BEGINS ..	MID-WAY[2] ..	8 AUG.	
AUTUMNAL EQUINOX	23 SEPT.		

¶ 2. STONEHENGE TEMPLE OBSERVATORY AND ALMANAC CIRCLE. (Plates I and II).

In our own country there exist hundreds of ancient structural devices for indicating the principal points of the two recognised forms of the Solar year. The best-known monument of this nature is that of the Stonehenge circle. This consists of the arrangement of upright stones and lintels contained within the earthwork circle, as figured restored, on Plates I and II. The Avenue Approach to the Circle cuts the Earthwork circle as shown on the Plates.

Stonehenge Alignments define the points of the Solar Astronomical and Solar Vegetation Years.

[1] "The Chinese *Shu-King*." W. G. Old, pp. 301-2, and note. Translation of Book I, Sect. I, pp. 1-2, and Translator's notes to same.
Encycl. Brit. (11th Edit.), Vol. VI, p. 317.

[2] By "Mid-Way" is intended 45° of *Right Ascension* from an Equinox or Solstice; not mid-way as defined by the interval in days.

Thanks to the admirable surveys of Sir William M. Flinders Petrie and Mr. Edgar Barclay, and Sir Norman Lockyer's[1] precise azimuth alignments, the purpose of the circle is now known with certainty.

As shown on Plate I, two separate alignments are directed to the horizon points of sunrise and sunset at the Summer Solstice and Winter Solstice respectively. Another alignment on Plate I gives the horizon point of Sunset at the beginning (May 6) and ending (August 8) of Summer, and of the horizon point of Sunrise at beginning (Nov. 8) and ending (February 4) of Winter.

Plate II shows the shadows thrown by the Stone Circle at Sunrise of Summer Solstice.

(Refer Section III Description of Plates ¶¶ 65 and 66).

¶ 3. OTHER BRITISH CIRCLES AND ALIGNMENTS.

Stenness, Orkney, Alignments define the points of the Solar Astronomical and Solar Vegetation Years.

Of equal astronomical importance to Stonehenge and its accessory alignments discussed by Lockyer and Barclay, are the circles and accessory alignments of Stenness, in Orkney. Mr. Magnus Spence was the first to show that these were connected with the Solar year and its principal datings. Investigations conducted by Sir Norman Lockyer confirm that the alignments were variously directed towards sunrise or sunset at the Solstitial and May and November points of the year.[2] The data at Stenness in the Orkneys, then, agree with the data at Stonehenge. Both define the principal points of the Solar Astronomical Year and of the Solar Vegetation year.

In this part of his subject Lockyer has some interesting evidence concerning the sighting purpose of the well-known perforated stones, met with in Britain and North-Western Europe, wherever similar astronomical alignments occur.[3]

Sixty-seven British Solar Astronomical and Vegetation Year Alignments.

Leaving out of consideration—as doubtful on archæological grounds—many of Lockyer's star rising and setting alignments in Britain, Lockyer discusses and tabulates twenty-five May alignments, eleven November alignments, and nineteen Summer, and twelve Winter Solstitial alignments in Great Britain and Ireland.[4]

¶ 4. ALIGNMENTS IN BRITTANY AND ELSEWHERE.

Thirty-four Solar Astronomical and Vegetation Year Alignments in Brittany.

Passing from Britain into Brittany, Lockyer finds eleven May alignments, three November alignments, six Summer and eleven Winter Solstitial alignments, and three Equinoctial alignments.[5]

[1] Petrie, "Stonehenge," Plates.
Lockyer, "Stonehenge and other British Stone Monuments," pp. 46 (Hoare's 1810 plan), 55-68 (Solstitial alignment), 88-95 (May-November alignment), 442-450 (The Welsh Gorsedd.—Solstitial and May-November alignments).
Barclay, "Stonehenge and its Earthworks," pp. 63-66 (Solstitial alignment), 66-67 (Equinoctial alignment and altitude), 70, 99-110 (November, February, May, and August Festivals, and March, June, September, and December Festivals). Barclay's Plates III and IV for alignments.
[2] Spence's "Standing Stones and Maeshowe of Stenness," *Scottish Review*, Oct., 1893.
[3] "Stonehenge and Other British Stone Monuments," pp. 37, 128, 282, 285, 286, 316, and 318.
[4] Ibid., Appendices, pp. 481 and 482.
[5] Ibid., Appendices, pp. 485-486.

As in parts of Britain, Lockyer[1]—quoting Baring-Gould—finds the May and August Festivals still celebrated in many parishes of Brittany. The same, however, is true of North-Western Europe, the reason being that, whereas Brittany lies on the Southern track of the megalithic builders from the East, the circles and alignments of North-Western Europe lie on the Northern track of the megalithic builders from Western Asia and Egypt.

Migratory Route indicated by Mediterranean and West European Megalithic Monuments:

" It must not be forgotten," says Lockyer, " that structures more or less similar to Stonehenge are found along a line from the East on both sides of the Mediterranean."[2]

Professor T. Eric Peet says that these " occupy a very remarkable position along a vast sea-board which includes the Mediterranean coast of Africa and the Atlantic coast of Europe. In other words, they lie entirely along a natural sea route."[3]

This confirms another statement by Lockyer that " the Druid culture (of Ancient Britain) had not passed through Gaul, and had therefore been water-borne to Britain."[4]

¶ 5. THE SEA ROUTE—WESTERN ASIA AND EGYPT TO BRITAIN.

As a matter of fact, the Libyo-Amorite route between Western Asia and the Atlantic coasts seems to have been almost entirely a sea route, rather than, as some have supposed, a North African Coast-Land route. The distribution of megalithic buildings along the coast of North-Western Africa and South-Western Europe is denser than along the coast of North-Eastern Africa. This undoubtedly points to the fact that these monuments were erected near colonized ports of call along the sea route to the ancient Portuguese, Spanish, British, and Baltic metal, amber, and jet deposits.

Megalithic Buildings near Ports of Call on Mediterranean Route.

The period for this earliest activity in maritime commerce between Britain and the East dates from before 2000 B.C. to 1200 B.C.[5]

Commercial Intercourse Circ. 2000 B.C. to 1200 B.C.

XVIIIth Dynasty Egyptian glazed beads (not made elsewhere, or by any other Egyptian dynasty than the XVIIIth and XIXth), were found at Stonehenge, together with beads of Baltic amber.[6] Similar beads of Baltic amber were also found in Egypt in XVIIIth and XIXth Dynasty remains.[7]

Stonehenge Egyptian Beads and Contemporary Amber in Egypt confirm Lockyer's Stonehenge date.

This identification of the period of Stonehenge confirms Lockyer's astronomical dating, 1680 B.C. ± 200 years, for the erection of the Stone Circle. Ancient British jet (from Whitby in Yorkshire) and worked pieces of Baltic amber have been found, in the deposits of the megalithic builders in Spain and Portugal, together with Egyptian ivory figures, a shell from the Red Sea, Egyptian alabaster and marble objects, and statuettes of a Babylonian type.[8]

[1] " Stonehenge and Other British Stone Monuments," pp. 198-199.
[2] " Dawn of Astronomy," p. 90.
[3] " Rough Stone Monuments," (1912), pp. 147-8.
[4] " Stonehenge and Other British Stone Monuments," p. 323.
[5] Mr. Donald A. Mackenzie's " Ancient Man in Britain," pp. 91-108, 218-222.
[6] Sayce, in Journal of Egyptian Archæology, Vol. I, Pt. I., p. 18. H. R. Hall, p. 19.
[7] H. R. Hall, p. 19.
[8] D. A. Mackenzie, " Ancient Man in Britain," pp. 96, 97.

¶ 6. FOLKLORE AND TRADITION.

Long prior to the discovery of these evidences, Lockyer conducted an exhaustive inquiry into local Folklore and tradition for evidences concerning Druidic origins.[1] His conclusions are clearly and ably summed up in his comprehensive article, "The Uses and Dates of Ancient Temples," in *Nature*, May 20th, 1909, as follows :—

Summary of Lockyer's Conclusions.

Ancient British Astronomical Evidences indicate Egyptian influence.

"At the first blush there appears to be no resemblance between the Egyptian and Greek temples and the British stone monuments, but a careful study of both shows that this view is an erroneous one..... In my inquiry I have not confined myself to the astronomical side of the question. I have tried to dip into the folklore and tradition already garnered in relation, not only to the sacred stones, but to the sacred wells and sacred trees.

Local Folklore and Tradition indicate Semitic influence or origin.

"From what I have learned I am convinced that much light will be thrown on both when an attempt shall have been made to picture what the lives of the first British astronomer-priests must necessarily have been.

"It is interesting to note that, while the astronomical side of the inquiry suggests a close connection with Egyptian thought, the folklore and traditions, when studied in relation with the monuments, indicate a close connection between ancient BRITISH and the SEMITIC civilisations.....The 'Druids' of Cæsar's time were undoubtedly the descendants of the astronomer-priests, some of whose daily work has now perhaps at last been revealed."

Modern Archæological Evidences indicate Eastern Origin of Megalithic Builders and identify them with Druids.

In this connection a knowledge of the conclusions reached by the eminent Belgian Archæologist, M. Siret, is of more than ordinary interest. Mackenzie states that as a result of M. Siret's investigations concerning the Eastern origin of the megalithic builders and metal workers in Ancient Britain, Spain, and Portugal,

[2]"Siret has found evidence to show that the Tree Cult of the Easterners was connected with the early megalithic monuments. The testimony of tradition associates the stone circles, etc., with the Druids. 'We are now obliged,' he writes,[3] 'to go back to the theory of the archæologists of a hundred years ago who attributed the megalithic monuments to the Druids. The instinct of our predecessors has been more penetrating than the scientific analysis which has taken its place.' In Gaelic, as will be shown, the words for a sacred grove, and the shrine within a grove are derived from the same root *nem.*"

[1] "Stonehenge and Other British Stone Monuments," pp. 178-260.
[2] D. A. Mackenzie, "Ancient Man in Britain," pp. 155-6.
[3] *L'Anthropologie* (1921), pp. 268 *et seq.*

¶ 7. CONCLUSIONS FROM RECENT DISCOVERIES.

Mackenzie,[1] from the more recent evidences similarly sums up his inquiry, as follows :—

The Ancient Portuguese and Spanish Oriental Colonies.

"The Celts appear to have embraced the Druidic system of the earlier Iberians in Western Europe, whose culture had been derived from that of the Oriental colonists."

The Iberian Ports of Call on the Sea Route to Ancient Britain.

"At an early period in the Early Agricultural Age and before bronze working was introduced, England and Wales, Scotland and Ireland, were influenced more directly than had hitherto been the case by the high civilizations of Egypt and Mesopotamia, and especially by their colonies in South-Western Europe."

¶ 8. THE ORIGINAL IDEA ADOPTED BY THE MEGALITHIC BUILDERS.

Our inquiry is concerned chiefly with the origin of astronomical observatories and almanac devices employed to fix and portray the principal points of the solar astronomical and solar vegetation years. The astronomical evidences, and the evidences from folklore and tradition, and from archæological sources, have shown us that the origin is carried back to the valleys of the Euphrates and the Nile.

The Egyptian Gizeh Pyramid Builders of Euphratean Origin.

Lockyer has shown us that the Pyramid builders of the IVth and Vth Egyptian Dynasties, must, from their astronomical cult, have come from the region of the Euphrates. He shows also, that nearly all the ancient year cults of the Nile Delta are connected with the Euphratean equinoctial year.[2] Petrie, too, finds an Euphratean origin for the Vth Dynasty of Egypt.[3]

The external purpose of the Great Pyramid adopted by the Megalithic Builders in Northern Africa, Spain, and Britain.

Confirming our deductions from the data, we find at once that the idea of the IVth Dynasty Great Pyramid builders in Egypt was the original of the idea followed by all the megalithic builders from Egypt to Spain and Britain. The Great Pyramid was built, not alone as a Sundial of the day, but primarily, in its external features, as a Sundial of the Seasons.

¶ 9. THE ANCIENT SUNDIAL OF THE SEASONS.

The Necessity for vast bulk, accurate orientation and perfection in workmanship.

One of the primary objects of early Pyramid *building* in ancient Egypt was undoubtedly to record and indicate automatically throughout the country the annual recurrence of the principal points of the two forms of solar year—the astronomical and the agricultural. No form of building, unless accurately and symmetrically built with proper reference to the North, South, East, and West, could be employed to effect this purpose. That the requisite *Sundial of the Seasons* should be a monument of public utility necessitated vast bulk, large external surfaces, the finest selected material, and extreme accuracy of workmanship.

[1] "Ancient Man in Britain," pp. 218 and 220.
[2] "Dawn of Astronomy," pp. 84, 85, 367-370.
[3] "History of Egypt," Vol. I, p. 85 (9th Ed.), p. 96 (10th Ed.).

Conditions fulfilled by Gizeh Pyramids.

Ideal Site for Seasonal Sundial of the Delta.

All the necessary requirements are fulfilled by the gigantic proportions of the Pyramids of Gizeh, by their accurate orientation, and by their precision of workmanship. Then the site selected, on the elevated plateau of Gizeh, westward of the adjacent agricultural land,—the inhabited and cultivated strip of the Nile—and centrally south of the cultivated Delta, was the only possible site for the effective utilisation of the structural features. The admirable nature of the selected site, for the purpose indicated, is seen by reference to Plate III—Map of the Nile Delta—and Plate IV—Map of the Pyramids and Tombs on the Plateau of Gizeh—and by reference to the upper view of the frontispiece.

¶ 10. THE REFLECTING SURFACES OF THE GREAT PYRAMID OF GIZEH.

The Great Pyramid's External Surfaces perfected for Reflections.

Conceived and built the first of all the Pyramids of Gizeh, the Great Pyramid embodied in its external casing all the knowledge of the Ancients concerning the properties of the Sundial. Planned to effect its purpose primarily by means of reflected sunlight, and secondarily only by means of shadows, the casing of the Great Pyramid was selected from the whitest and best limestone from the quarries of Turra and Masara, on the opposite or Eastern side of the Nile.

The Refinement of Accuracy of Plane Surfaces of Beds, Joints, and Exposed Faces.

To ensure accuracy and continuity of unbroken plane, free from visible joints and beds, in the casing surface of each face slope of the Great Pyramid, the beds and joints, and the visible surfaces of all casing stones were worked as accurately as modern optician's work, but with this degree of accuracy extending to considerably larger surfaces. All joints and beds were so accurately fitted that even at this date a sheet of note-paper cannot be inserted between the stones still remaining unbroken and undisturbed *in situ*. Yet all these joints and beds were run with a fine film of cement.

Flaws cut out and refilled without sign of restoration.

Another remarkable feature of constructional detail confirms the high degree of accuracy and smoothness of surface that was considered necessary. Flaws in the visible surfaces of the casing stones were cut out and refilled with accurately fitting pieces of limestone, invisibly cemented in. This indicates that the intention was to obtain the whole external visible surface so uniformly smooth and plane as to present a polished unbroken reflecting surface on all four casing sides of the Great Pyramid.

The Great Pyramid's Name in Ancient Egypt, "The Lights."

It is obvious that it was from the brilliant reflexions from its casing slopes that the Great Pyramid is named, in the inscriptions of the Pyramid period, and in inscriptions of later times, *Khuti*, "the Lights."[1]

¶ 11. THE REFLECTED RAYS TRANSFORMED INTO VISIBLE EFFECT.

Name and Evidences imply that Reflexions were transformed into visible effect.

That the Pyramid's reflexions were transformed into visible effect, or were themselves rendered visible—at least around the hour of noon-day—is certain

[1]Brugsch, "Egypt under the Pharaohs," Vol. I, p. 73. Revised English Edit. (3rd), 1902, p. 35.

both from the Pyramid's ancient name, "The Lights," and its structural evidences. Bearing in mind all the evidences pointing to special preparation and intention, it is clear that the site selected, and certain special details of construction referred to later, had some connection with this matter. It is in this connection that many of the Pyramid's structural features—and certain outstanding features of its environment—seem to suggest advanced problems for the physicist. These all tend to indicate that the Pyramid was designed and located upon the conception that the mid-day reflexions would be rendered visible.

Special features suggest advanced problems for the Physicist.

Designed and Located on the conception that reflexions would be visible.

That the atmospheric conditions within and bordering on the desert regions around Egypt furnish the essential conditions for the formulation of the conception noted is clear from the authentic observation quoted in ¶ 76b. (Section III of this Chapter.) In this case heliograph messages were read, not from the mirror disc—which was invisible to the accidental observer—but from the rise and fall of the actual beam of light reflected from the disc. The accidental observer was remotely placed with reference both to the point and line of projection. The atmospheric phenomenon can only be accounted for by the presence of myriads of minute particles in suspension in the air, such as are deemed to produce the phenomenal deep blue in the sky of dry desert atmospheres, and in atmospheres in proximity to such desert zones. (Refer ¶¶ 76, a and b, Sect. III.)

Authentic case of reflected beam visible in Egypt.

Morse coded message read from beam projected from Heliograph when flash invisible.

The Function of Atmospheric Dust in Dry Climates.

Desert Atmospheres.

The question of the Pyramid's reflected rays becoming visible is, then, a question, primarily, of atmospheric conditions around the Pyramid. Here the reader must remember that the Pyramid Designer was contemplating the "mass production" of reflexions on a scale beyond anything within ordinary human experience. Devices were accordingly perfected to prevent diffusion of the reflected light and to stabilise the reflected rays under the influence of variable surface refractions due to heat radiations. (Refer ¶¶ 18 and 19.)

Question primarily concerning Atmospheric Conditions.

"Mass Production" of Reflexions.

Accessory Details of Construction.

It is important, however, that the reader should bear in mind the alternative questions as to whether the reflexions were transformed into visible effect or were themselves rendered clearly visible around noon-day. At the same time it simplifies matters for the general reader to adopt the view that the reflexions were visible. Description of the various phases of the Pyramid's phenomena will be made on this understanding.

Alternatives: (a) Reflexions transformed into visible effect, or (b) Reflexions visible at noon-day.

Latter alternative adopted for description of phenomena.

¶ 12. THE GREAT PYRAMID'S NOON REFLEXIONS. Plates V, VI, VII, VIII, and X.[1]

Exactly as a modern chronometer gives the hours, say of midnight, 6 a.m., noon, and 6 p.m., so the reflexions from the Great Pyramid gave accurately the days upon which the Winter Solstice, the Spring Equinox, the Summer Solstice, and the Autumnal Equinox occurred. This precisely defined the Solar Astronomical Year.

Great Pyramid's Noon reflexions fix the principal points of the Solar Astronomical and Solar Vegetation Years.

[1]Technical details as Tabulated in Tables VI and VII at end of Section I.

South Noon Reflexion above the horizontal during Autumn, Winter, and Spring, below the horizontal during Summer

The principal points of the Solar Vegetation Year, however, were equally well defined. It is this definition of the Vegetation Year that forms one of the most striking series of phenomena connected with the Pyramid's exterior. For whilst the *noon* reflexion of the Pyramid's South face always pointed due South at the instant of noon—during Winter, Spring, Summer, and Autumn—it displayed the striking property of being elevated above the horizontal each day of Autumn, Winter, and Spring, and depressed below the horizontal during the entire extent of Summer.

¶ 13. THE PYRAMID'S PRECISE DEFINITION OF SUMMER LIMITS.

South Noon Reflexion horizontal at beginning and ending of Summer.

This is as shown on Plate V, Figs. B and b. Fig. B represents the Pyramid and its noon reflexions as shown in plan. Fig. b represents the elevation of the Pyramid and its reflexions as seen from the East. The noon reflexions shown are for the day beginning Summer, and for the day ending Summer, respectively 6th May and 8th August—of modern Calendar—as stated in Table I.

The diagrams show that exactly mid-way between the Vernal Equinox and the Summer Solstice, and, again, exactly mid-way between the Summer Solstice and the Autumnal Equinox, the beam reflected at noon from the Pyramid's South face, was truly horizontal. This horizontal reflection defined the first noon of Summer and the last noon of Summer. Between these two dates, 6th May and 8th August, the noon reflexion from the Pyramid's South face cast a triangular reflexion on the ground, and at no other period of the year. The triangular south noon reflexions, therefore, define the days of Summer. These south reflected images obviously shorten approaching the Summer Solstice, the shortest length of triangular image being attained at noon of the Summer Solstice, after which, again, the images lengthen until noon of the last day of Summer, when the noon reflexion becomes horizontal again.

Ten days after the commencement of Summer and ten days before the termination of Summer, at noon, the line RBCQ, formed by the East and West noon reflexions (Plate V, Fig. b), became a straight line running directly from East to West.

South, East, and West Noon Reflexions Shortest and North Noon Reflexion longest at Mid-Summer

Plate VI shows the Pyramid reflexions for noon of the Summer Solstice. These are respectively the shortest noon reflexions of the year from the South, East, and West faces of the Pyramid, and the longest noon reflexion of the year from the North face of the Pyramid.

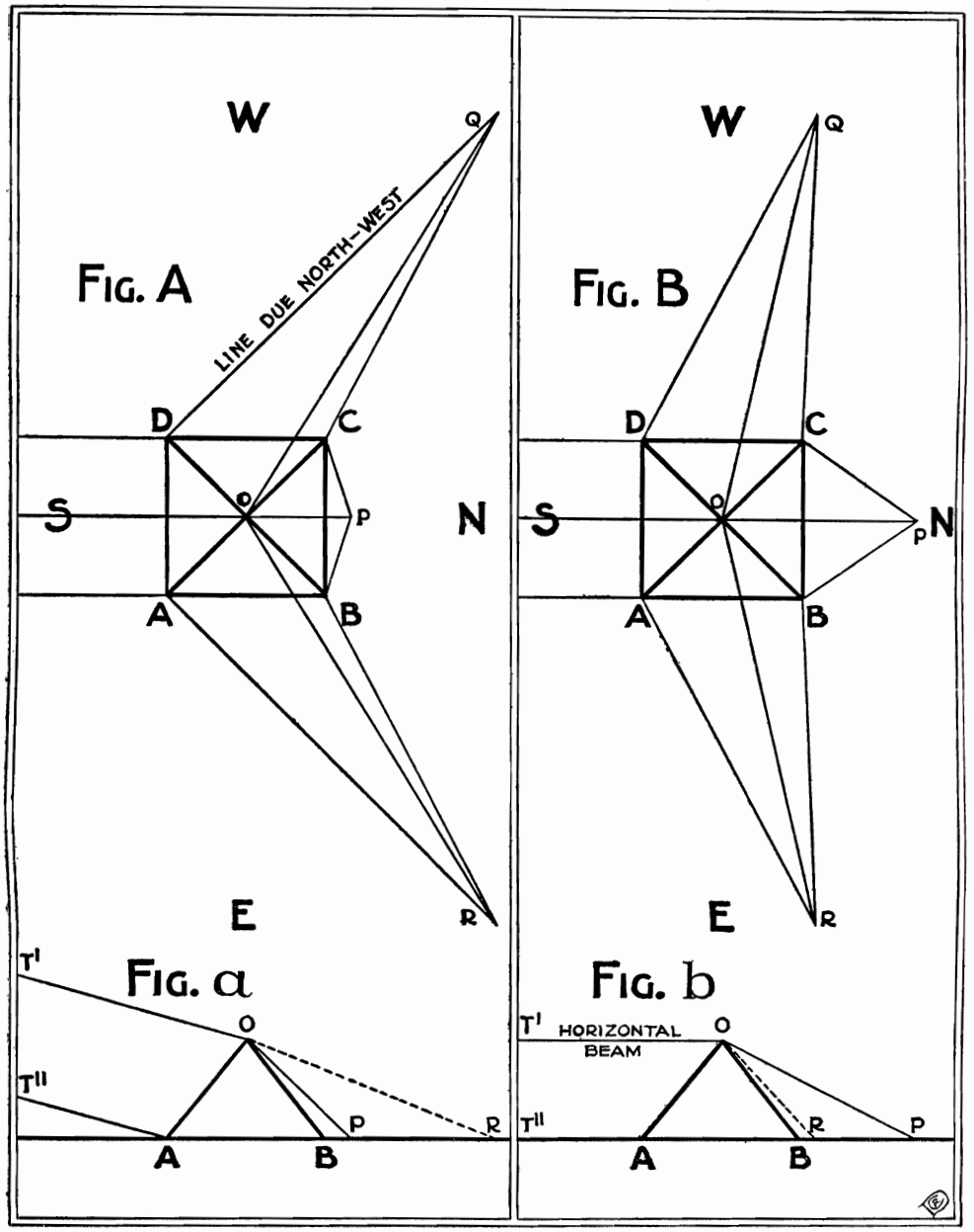
No Noon Shadow during Summer.

During the Summer half of the year no shadow was thrown by the Pyramid at the instant of noon, nor for an appreciable interval before and after noon.

PLATE V.

PYRAMID NOON REFLEXIONS & SHADOWS

NOON REFLEXIONS OF THE SUMMER HALF OF THE YEAR.



Autumnal Equinox or Vernal Equinox
REFLEXIONS.

Midway between Vernal Equinox,
and Summer Solstice,
Midway between Summer Solstice
and Autumnal Equinox
REFLEXIONS.

PLATE VI.

PYRAMID NOON REFLEXIONS & SHADOWS

NOON REFLEXIONS AT SUMMER SOLSTICE.

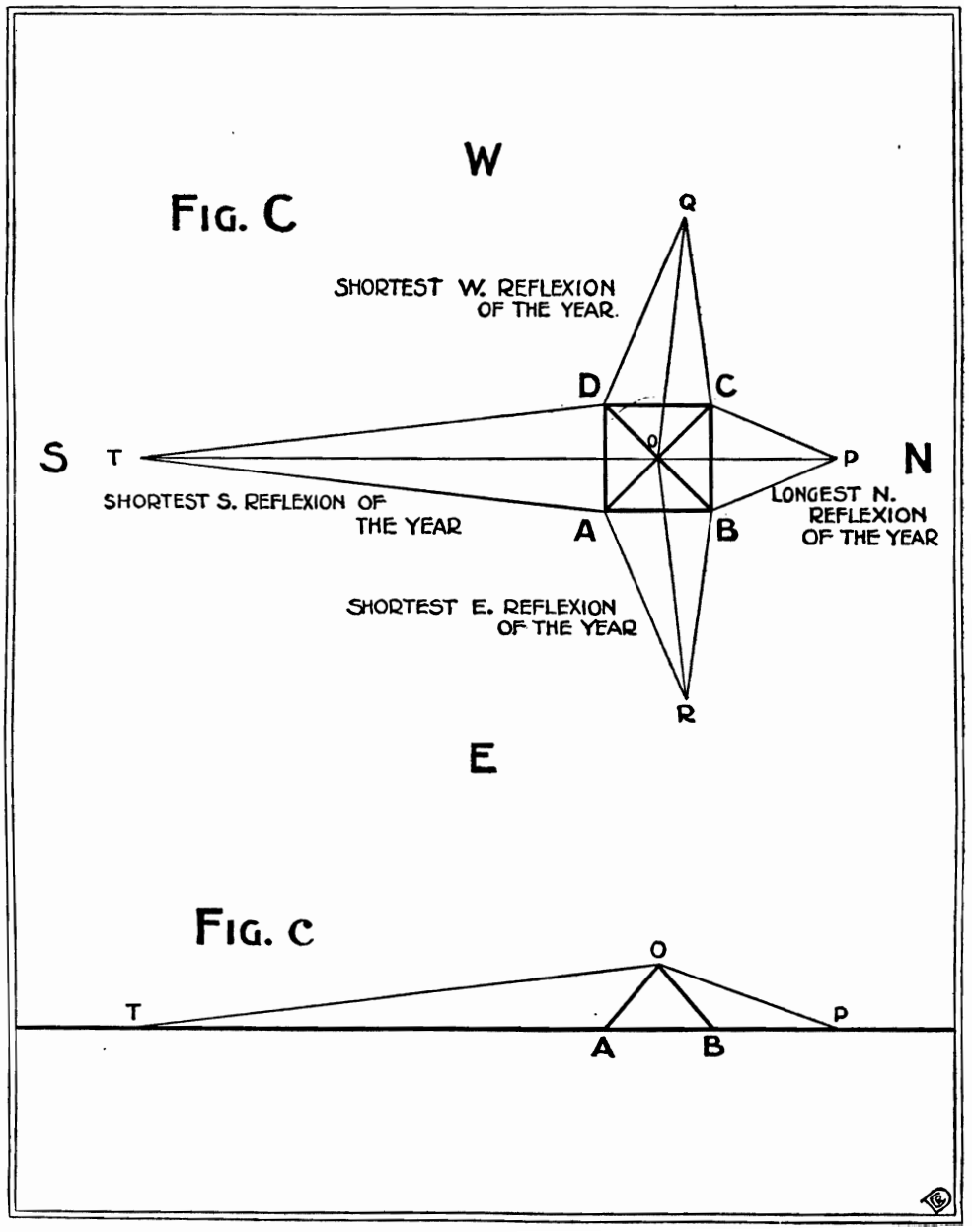


PLATE VII.

PYRAMID NOON REFLEXIONS & SHADOWS

NOON REFLEXIONS & SHADOWS.
14-15 OCT. NOON SHADOWS 1ST APPEARING.
27-28 FEB. NOON SHADOWS 1ST DISAPPEARING.

NOON REFLEXIONS & SHADOWS.
OF THE WINTER HALF
OF THE YEAR.

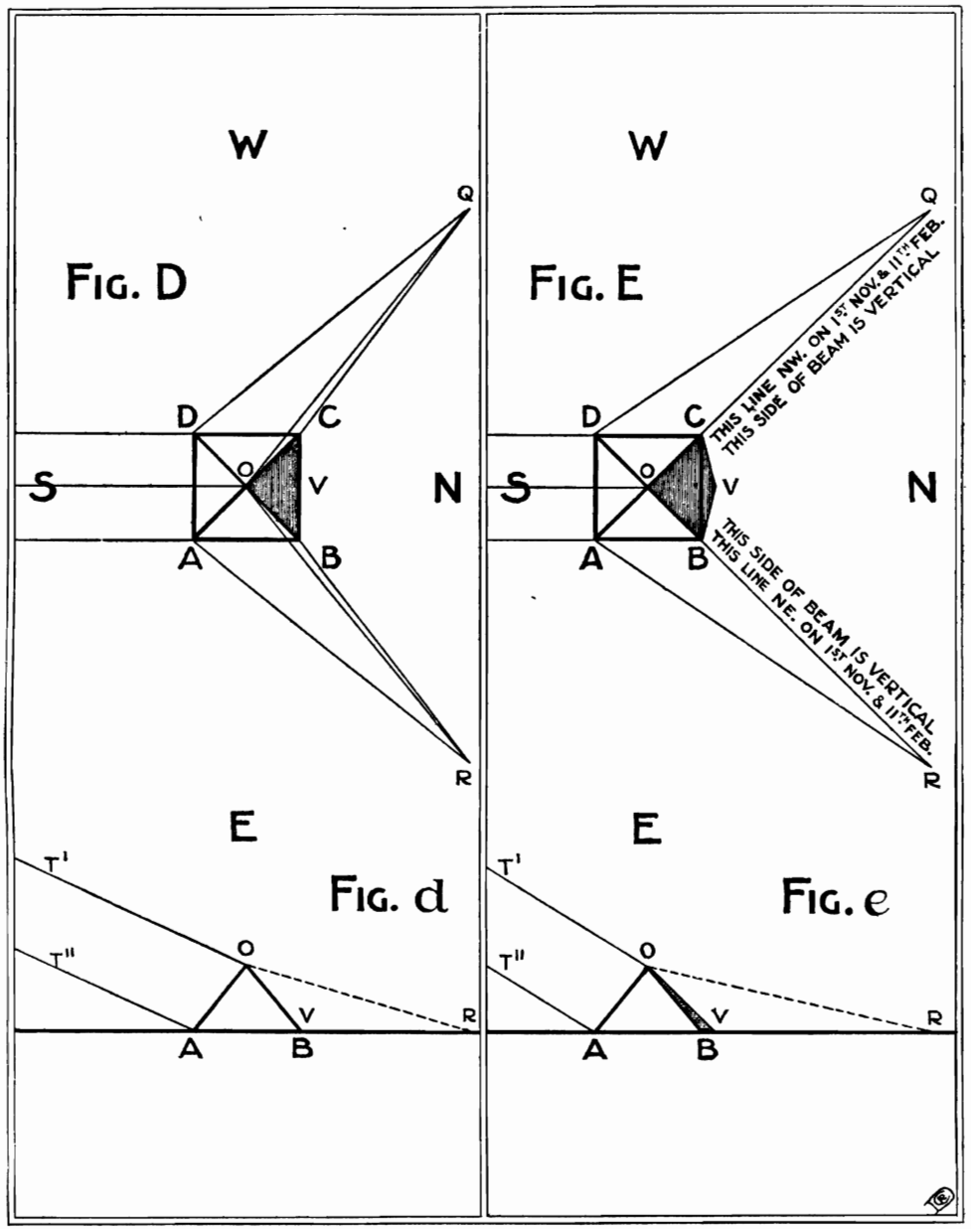
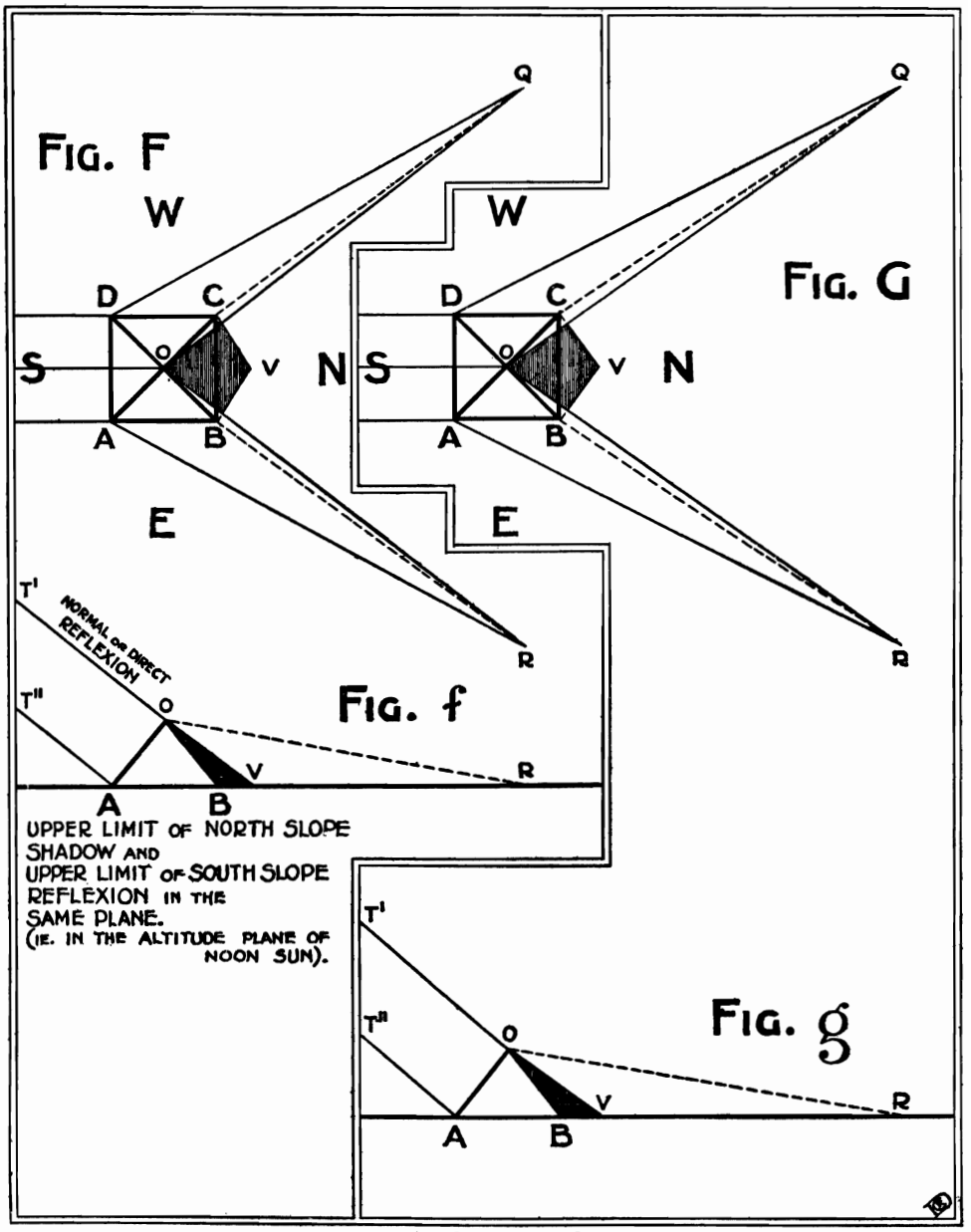


PLATE VIII.

PYRAMID NOON REFLEXIONS & SHADOWS

NOON REFLEXIONS AND SHADOW.
2 – 3 DEC. AND 11–12 JAN.



WINTER SOLSTICE NOON REFLEXIONS AND SHADOW

¶ 14. THE PYRAMID'S EQUINOCTIAL NOON REFLEXIONS.

The East and West Noon Reflexions define North-East and North-West Directions at the Equinoxes

The noon reflexions from the East and West faces of the Pyramid projected triangular images (Plates V to VIII) on the ground on each day of the year. Almost East and West respectively at the Summer Solstice (Plate VI), the Apex of each triangular image was North-East and North-West respectively from the East and West corners of the South Base side of the Pyramid at the instant of Vernal Equinoctial and Autumnal Equinoctial noon (Plate V, Fig. A).

This may be otherwise stated as follows :—(Plate V, Fig. A).

The East noon reflexion from the Pyramid projected a triangular image ARB, on the ground. This triangle consisted of a base, AB, lying on the Pyramid's East Base Side, AB, and of two other sides, which we may define, in terms of the plan, the South side, AR, and the North side, BR, of the triangular image. Thus defined, the line of the South side, AR, of the triangular image, pointed due North-East at Vernal Equinoctial and Autumnal Equinoctial noon. This was precisely the case during the period in history when the Pyramid was thus operating as a Sundial of the Seasons. In modern times the phenomenon noted would occur a day or so before the Vernal Equinox, and a day or so after the Autumnal Equinox.

Similarly defined (and with reference to Plate V, Fig. A), the line of the South side, DQ, of the triangular image, DQC, projected from the West face slope of the Pyramid, pointed due North-West at Vernal Equinoctial and Autumnal Equinoctial noon.

¶ 15. THE PYRAMID'S DEFINITION OF WINTER.

The solid beams of reflected light proceeding from the East and West face slopes of the Pyramid at noon had a further remarkable property defining Winter as distinct from Spring, Summer, and Autumn. Reference to Plates V to VIII shows that in all cases the East and West Solid noon reflexions had a sharply defined ridge line running from the Pyramid apex to the apex of each of the images projected on the ground.

Surface of East or West Noon Reflexion seen from North inclined overhanging towards observer in Winter and inclined away from observer in Spring, Summer, and Autumn.

The East and West noon reflected beams had, therefore, each a surface seen from the North side of the Pyramid, and a surface seen from the South side of the Pyramid. The side of the East or West noon reflected beam, as viewed from the South, always, throughout the year, appeared inclining away from the observer. The side of the East or West noon reflected beam, however, as viewed from the North side of the Pyramid, appeared inclining away from the observer during Spring, Summer, and Autumn, but appeared overhanging towards the observer during Winter, as shown on Plate VIII, Figs. F and G.

At Beginning and Ending of Winter this surface truly vertical and pointing North-East for East reflexion and North-West for West Reflexion.

1st November and 11th February thus defined.

At the beginning and ending of Winter this surface of either reflected beam as seen from the North was a truly vertical surface lying, in the case of the East reflection, truly North-East, and in the case of the West reflection, truly North-West, in continuation of the Pyramid's base diagonals. This is as shown on Plate VII, Fig. E. In terms of the modern Calendar, the dates are respectively November 1st and February 11th. Referring to Table I, the reader will observe that the former date anticipates the beginning of winter by seven days, and that the latter date succeeds the termination of Winter by the like interval of seven days.

It is obvious that the difference was not due to any error in fixing the precise beginning and ending of Winter. Had this been the case, there would have been a similar error in fixing the beginning and ending of Summer. But the phenomenon of the horizontal South noon reflexion fixes the beginning and ending of Summer with definitive precision. The difference of seven days, then, in anticipating the beginning of Winter can only have been an intentional anticipation, as the reader will see.

¶ 16. THE PYRAMID'S WINTER SHADOWS (Plates VII and VIII).

Pyramid Noon Shadows during Winter only.

October 14th to February 28.

A noon shadow was projected by the Pyramid during Winter and for sixteen or seventeen days before and after Winter. Between February 27-28 and October 14-15, no noon shadow appeared. During this period of the year a noon reflexion was projected by the North face slope of the Pyramid. On October 14-15, however, the noon reflexion disappeared and the first noon shadow made its appearance. (Plate VII, Figs. D and d.) Successive noons toward the Winter Solstice (Plate VII, Figs. E and e, Plate VIII, Figs. F and f), found the length of the noon shadow, projected on to the pavement base of the Pyramid, gradually lengthening towards the North, until at noon of the Winter Solstice it attained its greatest length due North (Plate VIII, Figs. G and g).

After the Winter Solstice the length of the noon shadow, projected on the pavement base, gradually shortened (Plate VII, Figs. E and e, Plate VIII, Figs. F and f), until at February 27-28 (Plate VII, Figs. D and d) it was " swallowed " by the Pyramid masonry, and the North noon reflexion made its first appearance, heralding the approach of the Vernal Equinox and the Summer *half* of the year.

Sowing and Harvest defined.

The initial and terminal datings of the noon shadow phenomenon defined respectively the beginning of early sowing, and the beginning of the barley and flax harvests in the ancient Delta. (The reader is referred to Plates III, IV, V, VI, VII, VIII, X, and XII, and to Section III, ¶¶ 67-72, 74 and 76, for the detailed descriptions of the various phenomena discussed.)

¶ 17. THE TEMPLE OF RAMESSU II AT ABU SIMBEL.

Alignment of Abu Simbel Temple Directed to Sunrise of Pyramid's Noon Shadow "Swallowing" Dates.

The influence of these initial and terminal datings of the Pyramid's noon shadow phenomenon in formulating later devices for automatically heralding the seasons is evidenced by the Temple of Ramessu II at Abu-Simbel. This temple was built with its central axis aligned towards the point of Sunrise of the day upon which the Pyramid's noon shadow first appeared, and of the day upon which it disappeared.

Now the sun's noon altitude for a certain point of the year when compared with the azimuth of its rising at the same point of the year over a long interval of years does not bear the precisely fixed relationship the Abu-Simbel alignment would lead one to suppose. For this reason, sunrise on the Abu-Simbel alignment cannot always occur on the same day as the Pyramid's noon shadow first appears or first disappears, respectively. Nevertheless the difference at the present time is not more than two days. The Sun rises on the Abu-Simbel alignment, at the present time, on October 16 and February 26,[1] whereas the Great Pyramid's limiting dates. for the present time, are October 14 and February 28 generally.

¶ 18. THE PYRAMID'S STRUCTURAL CORRECTION FOR REFLEXIONS.

The Pyramid's device for stabilising refraction variations.

To define more clearly the ridges and edges of the reflexions and to counteract the local dispersing effect of the variable surface refractions due to heat radiations from the Pyramid's surfaces, these surfaces were very slightly hollowed inwards towards the centre line of each face slope of the Pyramid. This slight hollowing, while tending towards stabilising and more clearly defining the reflected beams, was not sufficient to focus the reflected rays forming a beam of reflexion. The hollowing was not in the form of a concavely curved surface, but in *the general form* of two plane surfaces meeting along the centre line of each face slope. This feature, however, will be dealt with later.

The Hollowing inwards of the Pyramid's Face Slopes

Core Masonry hollowing proves device not an afterthought.

That the hollowing feature noted was not merely the result of an afterthought is evidenced by the core masonry of the Pyramid. The stepped surface of each face slope of the core masonry was likewise hollowed in to the same extent,[2] preparatory to the external casing stones being added to form the smooth reflecting surfaces. This hollowing is so small in proportion to the Pyramid's mass, and extent of external surface, that it is not visible to the eye *unaided*. It can be observed, however, and its extent measured by careful sightings across and obliquely up each face escarpment. The reader must not confuse the evidence of hollowing in with the separate question of dilapidation. The two can be quite separately surveyed.

[1]Hon. E. M. Plunket. P.S.B.A., March, 1893.
[2]Petrie, " Pyramids and Temples of Gizeh," pp. 43 and 44.

¶ 19. THE EXTENT OF THE STRUCTURAL CORRECTION.

Centre of each Pyramid Base Side about one yard internal to Pyramid Base Square.

The structural effect of the hollowing inwards of each face slope of the Great Pyramid was that the Pyramid base sides were hollowed inwards between the corners of the Pyramid base. These corners were the four corners of a square of about 760 feet length of side. The central hollowing in of each base side is almost exactly three feet, as determined from Petrie's survey.[1] The ratio of hollowing in of base to length of base side is therefore about 1 in 250.

Hollowing Inwards made correction for optical illusion.

This receding camber was sufficient to make correction for the well-known optical illusion whereby a large plane escarpment appears to bulge outwards. Correction for this optical illusion was made by the ancient Egyptians in the case of their monolithic beams and lintels, and by the ancient Greeks in the case of their columns. A truly level beam appears to sag in the middle; a slight camber upwards eliminates the illusion. A large vertical column appears to overhang towards the observer on the ground; a slight tilt away from the observer removes the illusion.

¶ 20. NOON SHADOW AND STRUCTURAL CORRECTION.

The Hollowing-in feature permitted 14 October or 28 February Noon Shadow Limit to be observed in relation to Side of Pyramid Base Square.

In the centuries following the Pyramid's construction, the limit of the 14th October and 28th February noon shadow, once in about every hundred years would lie precisely on the line forming the North side of the Pyramid base square (although the coincidence nearly occurred once in each modern leap year period). Let us, for the purpose of illustration, suppose the period exactly one hundred years and that the shadow limit lay on the North side of the base square exactly at the middle date of the period. Then fifty years before, or fifty years after the middle date, the shadow limit lay 31½ inches within the North side of the Pyramid base square, or 31½ inches without the square respectively. These dimensioned limits are true whether the period is greater than or less than the hundred years assumed. For other years within the period, the limit of the noon shadow lay somewhere between the two limits, 31½ inches internal to or external to the North side of the Pyramid base square.

The noon shadow limits for 14th October and 28th February, when internal to the North side of the Pyramid base square, were, owing to the hollowing-in feature, always defined and measurable. The extent of hollowing at the centre of the base side gave a margin of about 4½ inches between the casing edge and the maximum internal limit of the noon shadow under consideration. This marginal space was just sufficient to permit of the noon shadow being clearly defined at its maximum internal limit. The marginal amount, therefore, confirms the hollowing effect as intentionally of the extent observed by Petrie's sightings.

[1] "Pyramids and Temples of Gizeh," pp. 43 and 44.

The reader will see for himself that owing to the hollowing-in feature, the particular year of the modern Leap-year cycle—generally four years—was defined by the extent of the North face slope that was covered by shadow down the centre at noon on 14th October or 28th February. In other words, the variations of the noon shadow limit automatically affected the intercalation of the Solar year.

The Shadow Limit automatically Intercalated the Solar Year.

¶ 21. THE GREAT PYRAMID'S ANNUAL MESSAGE TO THE DELTA.

Within two periods, then, of sixteen or seventeen days, we find that the Great Pyramid provided two outstanding phenomena defining fixed points of the Solar year. These were the North-East and North-West directed vertical surfaces of reflection at noon of 1st November and 11th February, and the North noon shadow limits on 14-15 October and 27-28 February. Both sets of phenomena were devised to be seen from the North.

Great Pyramid sited to enable its 14th October and 1st November and 11th February and 28th February Phenomena to be seen from the North.

Reference to Plate III—studied in relation to Plate VII—will show that the Pyramid site was selected with all this as part of the design.

The Great Pyramid is so situated that it is the centre of the quadrant of a circle that defines and includes the Delta (Plate III). The two Limiting Radii of the Quadrant lie North-East and North-West respectively, forming the angle of 90° subtending the quarter circle arc of the Delta coastline, from near the modern site of Port Said to near the modern site of Alexandria.

The Pyramid's situation and its accompanying coincidence with the centre of the Delta Quadrant might be deemed to be accidental were it not for the fact that the directions of the limiting radii of the quadrant were annually defined by the Vertical Surfaces of the Pyramid's East and West noon reflexions on 1st November.

Pyramid's North-East and North-West Vertical Surfaces of Noon Reflexions on 1st November define the Delta Quadrant.

¶ 22. THE GREAT PYRAMID'S PART IN ORGANISING CULTIVATION IN THE DELTA.

The significance of the Pyramid's phenomena and their datings is seen at once when we remember that the early sowing period in the Delta occurred between the 14th October and the beginning of the general sowing season on 1st November; that the early harvesting period occurred between 11th February and the beginning of the general harvest season at 27-28 February, when barley was reaped and flax plucked.[1]

The Pyramid's Noon Phenomena define early Sowing Period 14th October 1st November and Early Harvest Period 11th February —28th February.

The appearance of noon shadow on the North Face of the Pyramid—seen only from the Delta—heralded early sowing on 14-15 October. The verticality of the surfaces of the East and West noon reflexions—seen only from the North—, and running truly North-East and North-West respectively, heralded the general beginning of the sowing season on 1st November.

Heralding of Agricultural Seasons intended for the Delta.

[1]For Wilkinson's Agricultural Datings refer Plate IX, cols. 7, 8, and 9.

The recurrence of the latter phenomenon again, at noon of 11th February gave warning to the Delta of the earliest date for an early harvest; and the disappearance of noon shadow from the North Face of the Pyramid on 27-28 February heralded to the Delta the beginning of the barley and flax harvests.

These facts immediately raise the question as to whether the ancient Egyptians at the time of the Pyramid Dynasties had not a fixed Calendar year, adjusted by intercalation to conform with the Solar year.

¶ 23. THE ANCIENT EGYPTIAN CALENDAR.

The Calendar Years, 360 and 365 days.

The Ancient Egyptians, we know, had two forms of Calendar Year. They had a Calendar Year of 360 days and a Calendar year of 365 days. The last five days of the latter Calendar Year were known from the earliest times as the "five days over the year." This expression clearly indicates that the earliest calendar year was that of 360 days.

Each Calendar Season 4 months of 30 days.

Both forms of Calendar year consisted of the same seasonal divisions (Plate IX, col. 2). There were three Calendar seasons, each of four months, and each month consisting of 30 days. The seasonal divisions were respectively :—

(1) SHAT, the Calendar Season of Sowing.

(2) PERT, the Calendar Season of "coming forth," *i.e.*, growing and harvest.

(3) SHEMUT, the Calendar Season of Inundation.

Calendar instituted when a November Agricultural Year was observed.

The Calendar year began with the Calendar Season of Sowing. This fact clearly indicates that the Egyptian Calendar was instituted when a November agricultural year was observed.

¶ 24. THE FIXED CALENDAR YEAR OF EARLY EGYPT.

Plates IX, X, and XI.

Earliest Calendar Year 360 days.

Began with Calendar Season of Sowing.

The latter fact seems to be very obvious. But that is not all. The earliest form of Egyptian Calendar was the Calendar year of 360 days. This began with the Calendar season of Sowing. Such a definite designation implies a definite synchronism with the actual season of sowing at the time the designation was first given.

Designation made when a Fixed November Year observed.

Implies Intercalary Month added every 5 or 6 years

Fixed Year during period of Dynasties I to XVI

It is obvious, therefore, that the earliest Calendar year of 360 days was a fixed Calendar year identified with the November Agricultural year. A Calendar year of 360 days could only be a fixed Calendar year by intercalations of an additional month of 30 days at variable intervals of five or six years. That this was the form of Calendar employed—coincident with an intercalated Calendar year of 365 days—during the period of Dynasties I to XVI inclusive, is confirmed by the evidence discussed in Section II of this Chapter, and descriptions of Plates IX, X, and XI.

PLATE X.

CHART OF LIMITS OF EARLY EGYPTIAN INTERCALATED CALENDAR YEAR, EGYPTIAN SEASONS, AND GREAT PYRAMID NOON REFLEXION AND SHADOW PHENOMENA STATED WITH REFERENCE TO THE MODERN (GREGORIAN) MONTHS.

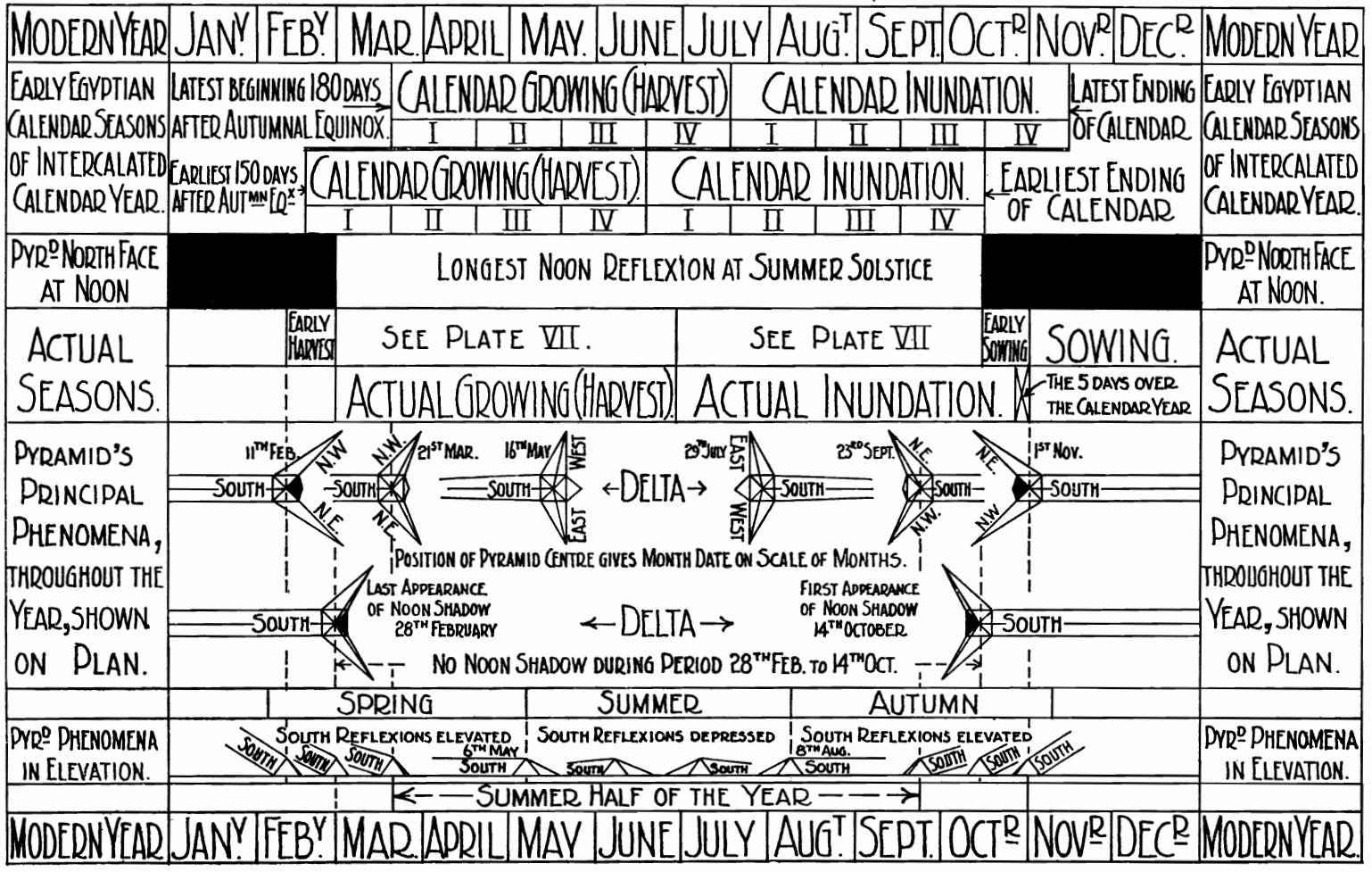


PLATE XI.

RECORDS OF THE PERIOD OF DYNASTIES VI TO XII OF DISTANT QUARRYING EXPEDITIONS TO THE QUARRIES AT WADY HAMMAMAT AND HAT NUB, AND TO THE MINES AND QUARRIES AT SINAI.

CALENDAR DATES OF HARVEST RECORDS	RECORDS OF DISTANT QUARRYING EXPEDITIONS TO												EARLY EGYPTIAN CALENDAR YEAR	
	HAMMAMAT				HAT-NUB				SINAI					
	DAY OF MONTH	YEAR OF REIGN	DYN.	KING	DAY OF MONTH	YEAR OF REIGN	DYN.	KING	DAY OF MONTH	YEAR OF REIGN	DYN.	KING	CALENDAR MONTH	CALENDAR SEASON
					—	25TH	VI	PEPY I					I	CALENDAR SEASON OF SOWING
	—3—	2ND	XI	MENTUHOTEP II									II	
	—15—	2ND	XI	MENTUHOTEP II										
	23 25 28	2ND 2ND 2ND	XI XI XI	MENTUHOTEP II										
	—1—	2ND	XII	AMENEMHAT III									III	
	—	16TH	XII	SENUSERT I										
	—13—	3RD	XII	AMENEMHAT III					—12—	—	XII	AMENEMHAT III		
		20TH	XII	AMENEMHAT III										
	—2—	1ST	VI	ATY									IV	
	—4—	36TH	XII	SENUSERT I										
DYN. XII FLAX HARVEST (EL BERSHEH) 23RD–27TH DAYS OF MONTH		11TH	XII	SENUSERT II										
		14TH	XII	SENUSERT III										
SENUSERT I (DYN XII) YEAR 18 THROWS NUBIAN GRAIN INTO NILE IN THIS MONTH ON 8TH DAY OF MONTH.	—												I	CALENDAR SEASON OF GROWING AND HARVEST
	—15—	19TH	XII	AMENEMHAT III										
													II	
SENUSERT III (DYN XII) YEAR 16. PRIOR TO RECORD OF THIS MONTH SENUSERT III REAPED GRAIN & BURNT SAME IN NUBIA.									HOR-UR-RA'S XIITH DYNASTY RECORD AT SINAI OF HOT WEATHER MONTHS BREASTED (RECORDS I p.322) PETRIE (SINAI p.169)				III	
													IV	
	—3—	8TH	XI	SANKH KARA									I	CALENDAR SEASON OF INUNDATION
													II	
	—	—	XII	AMENEMHAT I	QUARRYING X+17 DAYS	—	XI	MERENRA					III	
	—27—	18TH	VI	PEPY I										
	—3—	—	XII	AMENEMHAT I	DAYS X+17 NILE TRANSPORT	—	VI	MERENRA	—6—	18TH	VI	PEPY I	IV	

Apart altogether from this evidence, however, we know that the noon phenomena of the Great Pyramid automatically fixed the November Agricultural year. Now the Calendar years of 360 and 365 days were in use in Pyramid times, and the November year, beginning the sowing season, had previously been fixed—the fixing being monumentalised in the names of the Calendar seasons. It is clear then that the Pyramid's noon phenomena gave a high degree of accuracy to an adjustment of the Calendar year in relation to the Solar year that had already been long previously effected.

Great Pyramid's Fixing of November year gave accuracy to Adjustment Already effected.

The fixed November year, again, is confirmed by the dated *Calendar* records of the activities of the agricultural (or Solar) year during the period of Dynasties VI, XI, and XII. These are as graphically represented in Plate IX, Column 1, stated with reference to the Time Basis of Column 2, and as compared with actual conditions of Columns 7, 8 and 9, stated with reference to the Time Basis of Column 3.[1]

Dated Calendar Records Dynasties VI, XI, XII, confirm fixed November Year

¶ 25. THE FESTIVAL OF THE DEAD.

Attention has been directed (in ¶ 15) to the fact that the 1st November dating was intentionally observed instead of the beginning of Winter, seven days later. The 1st November Pyramid phenomena defined the first day of the fixed agricultural year of the Ancient Egyptians. It is with respect to this fixed 1st November year that the early Egyptian Calendar year was intercalated at the end of every five or six years. Hence the festival of the true beginning of the New Year was observed in Egypt at intervals of this duration as early as the time of Dynasties I and II.[2]

Period Egyptian Dynasties I and II, Calendar Year adjusted every 5 or 6 years to the Fixed 1st November Agricultural Year Beginning.

At the time of Dynasty XII, the celebration of the New Year festival took the form of lighting lamps for the dead on the last day of the old year and the first day of the New Year.[3] As Dr. Frazer has pointed out, this proves that the New Year's Festival at this time was the ancient Festival of the Dead—the modern All Souls', or All Saints' (1st-2nd November).[4]

Period Dynasty XII, lamps lit for dead on 1st November —the date of the Festival of the Dead—All Saints—All Souls.

"The custom," he remarks,[5] "was observed throughout the whole of Egypt," and is referred to by Herodotus (II, 62), as prevailing in the 5th Century B.C.

"On All Saints' Day, the 1st of November," Frazer continues, "the shops and streets in the Abruzzi are filled with candles, which people buy in order to kindle them in the evening on the graves of their relations: For all the dead come to visit their homes on that night, the Eve of All Souls', and they need lights to show them the way."

Ancient Custom still prevails in parts of Modern Europe on 1st to 2nd November.

Similarly, he states, "The Miztecs of Mexico believed that the souls of the dead came back in the twelfth month of every year, which corresponded with our November. On this day of All Souls the houses were decked out to welcome the Spirits."[6]

Ancient Mexican Celebrations in November.

[1] Detailed explanations are given in descriptions of Plates IX, X, and XI.
[2] For the data concerning this refer Section II, ¶ 56.
[3] Breasted, "Ancient Records," I, pp. 260-271. Frazer, "Adonis, Osiris, Attis," pp. 241-242.
[4] "Adonis, Osiris, Attis," pp. 241-2.
[5] Ibid., pp. 241-2.
[6] Ibid., pp. 244-8.

Frazer suggests that "The nominally Christian feast of All Souls' on November 2nd, appears to be an old Celtic festival of the Dead, adopted by the Church in 998 A.D.

All Souls and All Saints' derived from Festival of the Dead.

"The Celts and the Teutons appear to have dated the beginning of their year from the beginning of Winter, the Celts reckoning it from the 1st of November and the Teutons from the 1st of October.

"The feast of All Saints' on November 1st, seems also to have displaced a heathen festival of the dead."[1]

¶ 26. OSIRIS AND THE FESTIVAL OF THE DEAD: ISIS AND THE GREAT PYRAMID.

The Rites of Osiris were celebrated at the Festival of the Dead on 1st November in Ancient Egypt.

In the dual aspect of Osiris as corn or vegetation-god and god of the dead, the rites of Osiris embodied in one celebration, at the commencement of the November Vegetation Year, the rites of the agricultural deity and the rites of primitive ancestor-worship. In the sowing of the grain in November was seen the symbolic burial of the god; in its growth, his renewal of life; his resurrection; and, in harvest, the death and sacrifice of the god.[2] Thus Dr. Frazer states:—[3]

> "Under the names of Osiris, Tammuz, Adonis, and Attis, the peoples of Egypt and Western Asia represented the yearly decay and revival of life, especially of vegetable life, which they personified as a god who annually died and rose again from the dead."

The Pyramid's 1st November phenomena later associated with Osiris, his female counterpart becoming "The Queen of the Pyramid" and "The Mistress of the Commencement of the Year."

The rites of Osiris in ancient Egypt were annually celebrated on the day of the Festival of the Dead, November 1st. Owing to the fact that the noon reflections of the Great Pyramid defined the day of the celebrations, Osiris, in later Egyptian times, was associated with the Pyramid. Hence the fact that Isis, the female counterpart of Osiris, was designated in later times, "the queen of the Pyramid," and the "mistress of the commencement of the year." When the November year was discarded for the Sothic or Sirius Year, Isis followed the alteration of the year's beginning, and was identified with the star Sothis or Sirius. The original November year beginning aspect of the goddess was Hathor, later absorbed by Isis.

¶ 27. THE GREAT PYRAMID NOT AN INSTITUTION OF EGYPTIAN RELIGION.

Petrie's excavations at Abydos confirm statements of Herodotus and Manetho concerning Cheops, the Pyramid Builder

The accounts of Herodotus that Cheops (or Khuphu), the builder of the Great Pyramid, closed the Egyptian temples of the gods, and forbade sacrifice to the gods, and of the Egyptian priest, Manetho, that the same king "was arrogant towards the gods," have been confirmed by Professor Petrie's excavations at Abydos.[4] Furthermore, the simplicity of the Great Pyramid, and of other works belonging to the same reign, the utter lack of internal or external

[1] Ibid., pp. 254-5.
[2] A. Moret, "Kings and Gods of Egypt," pp. 69-108, 148-198.
[3] "Adonis, Osiris, Attis," p. 5.
Both are standard works on this subject.
[4] Abydos II, pp. 10, 30, 48.

ornament and inscription, removes the Pyramid entirely from the particular kind of religious atmosphere associated generally with every form of Egyptian architecture.

Cheops opposed to Egyptian forms of worship.

It seems clearly obvious, then, that the First of November phenomena of the Great Pyramid had *not* been devised to ensure the celebration of the rites of ancestor-worship, or the rites of Osiris, on this particular day. The traditions concerning the festival, however, indicate that it was considered to be the anniversary of an historical event, rather than of an event belonging to the astronomical or vegetational phenomena of the year. This again, is confirmed by the Pyramid indicating this date rather than the true beginning of winter.

Simplicity of Pyramid and contemporary work confirms this.

The Pyramid's 1st November phenomena for different purpose than fixing Celebration of Osirian Rites.

¶ 28. THE TRADITIONAL ORIGIN OF THE FESTIVAL OF THE DEAD.

As to the origin of the traditions concerning the festival of the dead, Haliburton[1] states as follows :—

> In Mexico " the festival of the dead was held on the 17th of November, and was regulated by the Pleiades.....They had a tradition that, at that time, *the world had been previously destroyed*, and they dreaded that a similar catastrophe at the end of a cycle would annihilate the race."

Mexican Festival of the Dead commemorated " Former Destruction of the World " in November.

The 17th of November[2] occurs also as an alternative dating of certain cults in Egypt during Dynasties XII and XIX, in Ptolemaic Egypt, and at the time of Plutarch. It occurs in Ancient Rome as an alternative date to 1st November.

The alternative 1st November and 17th November datings for the Festival.

According to Plutarch, the alternative dating, on the fixed Alexandrian (Julian) Calendar of his time, fell on the 17th day of the Egyptian month Athyr (Hathor).[3] In the XIIth Dynasty, the same alternative dating would be the 17th day of Month I, Season of Sowing,—the 1st month of the fixed 1st November year.

Reference to the Egyptian form of the traditional destruction of the world appears in the early Xth Dynasty Papyrus, Petersburg 1116A,[4] as " The Destruction of Mankind." The Xth Dynasty Papyrus states :—

> " .....God.....made heaven and earth (refer Gen. I, 1) at their desire. He checked the greed of the waters (refer Gen. I, 6-10) and made the air to give life to their nostrils (*i.e.*, by the removal of super-saturation from the atmosphere effected by process of Gen. I, 6 and 7. For previous conditions refer Gen. II, 5 and 6). They are His own images (refer Gen. I, 26, 27) proceeding from His flesh.....He slew His enemies and destroyed His own children because of their plots in making rebellion." (Refer Gen. VI, 5-7, 11-13, for causes.)

Dynasty X and Dynasty XIX narratives of the Destruction of Mankind in November give the form of the Hebrew narrative of the Deluge on Day 17 Month II of Calendar of Genesis.

The later form of the narrative, appearing in the tomb of Seti I of Dynasty XIX,[5] associates Hathor with the " Destruction of Mankind," which would account for the 17th day of the Egyptian month Hathor (the Athyr of Plutarch's account) being identified, in later times, with the Festival of the Dead.

[1] In Prof. C. P. Smyth's " Life and Work at the Great Pyramid," Vol. II, p. 390.
[2] Refer Section II, ¶ 55.
[3] Plutarch, *De Iside et Osiride*, Vol. II, p. 336.
[4] Translation by Dr. Alen H. Gardiner, " Journal of Egyptian Archæology," Vol. I, p. 34.
[5] Translation by Dr. Ed. Naville, " Records of the Past," 1st series, Vol. VI, pp. 105-112

¶ 29. HATHOR AND "THE DESTRUCTION OF MANKIND."

The Constellation associated with the Festival of the Dead is the Ancient November Constellation of Pleiades.

Outstanding features of the XIXth Dynasty story of the "Destruction of Mankind" fix that narrative as the Egyptian rendering of the narrative of the Noachian flood in Genesis, and of the ancient Mexican tradition of the destruction of the world, referred to by Haliburton. Commemoration of the latter, as quoted, "was regulated by the Pleiades."

The Pleiades associated with "Rain Giving."

Confirming the connection between the various forms of the narrative, Haliburton observes that the celebration of the festival of the dead by the Australian aborigines was held in November, when the constellation of the Pleiades is most distinct, and was specifically worshipped as "the giver of rain."[1] He says again that "The month of November was formerly called in Persia 'The Month of the angel of death.'"[2]

Hathor the November Angel of Death, but originally "The Floodgates of Heaven."

In the Egyptian XIXth Dynasty form of the tradition this "angel of death" appears as Hathor. Hat-hor, as Sir Ernest Budge shows,[3] was originally 'Het-Heru,' "The House of Horus," "one special part of the great watery mass of heaven," and was therefore a special part of "the waters above the firmament," of Genesis I, 9, and probably, therefore, the Deluge "floodgates of heaven" of Genesis VII, 11. The latter should more clearly be rendered "a finely spread restraining influence or natural law (*attenuated lattice-work* is the restricted application) upholding *the waters above the firmament.*" This sufficiently accounts for the 17th of the month Athyr (Hathor) being celebrated as the day of the festival of the dead in the Alexandrian Calendar period. For in the narrative of Genesis the Noachian deluge is given as beginning on the 17th day of the second month of the Calendar year of Genesis.

The 17th of the Month Hathor and the 17th of the Deluge Month.

The Seven Hathors and the Pleiades.

As to the association between Hathor and the ancient November constellation of Pleiades, the modern popular name—"the seven sisters"—of the latter constellation had its counterpart in Ancient Egypt as "the Seven Hathors."

Hathor associated with the Egyptian Flood.

The XIXth Dynasty narrative of the Destruction of Mankind states that "Ra ordered in the midst of the night[4] to pour out the water of the vessels, and the fields were entirely covered with water.....and there came the goddess (Hathor) at the morning, and she found the fields covered with water, and she was pleased with it and she drank to her satisfaction, and she went away satisfied, and she saw no men....."

This commemorated by Festival of Hathor originally on New Year's Day,—1st November.

Then Ra ordered "that libations be made to her at every festival of the New Year." The narrative defines this as the "festival of Hathor." Obviously it was originally New Year's Day, which in early Egypt fell on 1st November.

[1] Haliburton in Smyth's "Life and Work at the Great Pyramid," Vol. II, pp. 384-386.
[2] Ibid., p. 390.
[3] "Gods of the Egyptians," Vol. I, pp. 428-429.
[4] All Hallow's Eve or Hallowe'en ?

TABLE II.

ANCIENT INTERCALARY CYCLE AND ITS INTERCALARY PERIODS.

Cyclic years' duration.	Intercalated 360 days Calendar Year. Duration on Cycle in Months.		in Days.	Intercalated 365 days' Calendar Year. Duration on Cycle in Months.		in Days.	Number of days in mean years of Cycle. Days.
6	73	=	2190	73	=	2190	2191.45632
11	134	=	4020	134	=	4020	4017.66992
17	207	=	6210	207	=	6210	6209.12624
23	280	=	8400	280	=	8400	8400.58256
28	341	=	10230	341	=	10230	10226.79616
34	414	=	12420	414	=	12420	12418.25248
40	487	=	14610	487	=	14610	14609.70880
46	560	=	16800	560	=	16800	16801.16512
51	621	=	18630	621	=	18630	18627.37872
57	694	=	20820	694	=	20820	20818.83504
63	767	=	23010	767	=	23010	23010.29136
68	828	=	24840	828	=	24840	24836.50496
74	901	=	27030	901	=	27030	27027.96128
80	974	=	29220	974	=	29220	29219.41760
86	1047	=	31410	1047	=	31410	31410.87392
91	1108	=	33240	1108	=	33240	33237.08752
97	1181	=	35430	1181	=	35430	35428.54384
103	1254	=	37620	1254	=	37620	37620.00000

TABLE III.

THE CONSTRUCTION OF THE INTERCALARY CYCLE OF 103 YEARS.

Cyclic Years' Duration	Cumulative Days for Duration in Mean Years of Cycle	360 Days' Calendar Year.			365 Days' Calendar Year.		
		Duration on Cycle		Day I Month I Commencing Before (—) or After (+) Beginning of Mean Year of Cycle	Duration on Cycle		Day I Month I Commencing Before (—) or After (+) Beginning of Mean Year of Cycle
		In Months	In Days		In Months	In Days	
0	0.	0	0	0.00	0	0	0.00
1	365.24272	12	360	— 5.24	12⅛	365	— 0.24
2	730.48544	24	720	— 10.49	24⅛	730	— 0.49
3	1095.72816	36	1080	— 15.73	36⅛	1095	— 0.73
4	1460.97088	48	1440	— 20.97	48⅛	1460	— 0.97
5	1826.21360	60	1800	— 26.21	60⅛	1825	— 1.21
6	2191.45632	73	2190	— 1.46	73	2190	— 1.46
7	2556.69904	85	2550	— 6.70	85⅛	2555	— 1.69
8	2921.94176	97	2910	— 11.94	97⅛	2920	— 1.94
9	3287.18448	109	3270	— 17.18	109⅛	3285	— 2.18
10	3652.42720	121	3630	— 22.43	121⅛	3650	— 2.43
11	4017.66992	134	4020	+ 2.33	134	4020	+ 2.33
12	4382.91264	146	4380	— 2.19	146⅛	4385	+ 2.09
13	4748.15536	158	4740	— 8.16	158⅛	4750	+ 1.84
14	5113.39808	170	5100	— 13.40	170⅛	5115	+ 1.60
15	5478.64080	182	5460	— 18.64	182⅛	5480	+ 1.36
16	5843.88352	194	5820	— 23.88	194⅛	5845	+ 1.12
17	6209.12624	207	6210	+ 0.87	207	6210	+ 0.87
18	6574.36896	219	6570	— 4.37	219⅛	6575	+ 0.63
19	6939.61168	231	6930	— 9.61	231⅛	6940	+ 0.39
20	7304.85440	243	7290	— 14.85	243⅛	7305	+ 0.14
21	7670.09712	255	7650	— 20.10	255⅛	7670	— 0.10
22	8035.33984	267	8010	— 25.34	267⅛	8035	— 0.34
23	8400.58256	280	8400	— 0.58	280	8400	— 0.58
24	8765.82528	292	8760	— 5.83	292⅛	8765	— 0.83
25	9131.06800	304	9120	— 11.07	304⅛	9130	— 1.07
26	9496.31072	316	9480	— 16.31	316⅛	9495	— 1.31
27	9861.55344	328	9840	— 21.55	328⅛	9860	— 1.55
28	10226.79616	341	10230	+ 3.20	341	10230	+ 3.20
29	10592.03888	353	10590	— 2.04	353⅛	10595	+ 2.96
30	10957.28160	365	10950	— 7.28	365⅛	10960	+ 2.72
31	11322.52432	377	11310	— 12.52	377⅛	11325	+ 2.48
32	11687.76704	389	11670	— 17.77	389⅛	11690	+ 2.23
33	12053.00976	401	12030	— 23.01	401⅛	12055	+ 1.99
34	12418.25248	414	12420	+ 1.75	414	12420	+ 1.75
35	12783.49520	426	12780	— 3.50	426⅛	12785	+ 1.50
36	13148.73792	438	13140	— 8.74	438⅛	13150	+ 1.26
37	13513.98064	450	13500	— 13.98	450⅛	13515	+ 1.02
38	13879.22336	462	13860	— 19.22	462⅛	13880	+ 0.78
39	14244.46608	474	14220	— 24.47	474⅛	14245	+ 0.53
40	14609.70880	487	14610	+ 0.29	487	14610	+ 0.29
41	14974.95152	499	14970	— 4.95	499⅛	14975	+ 0.05
42	15340.19424	511	15330	— 10.19	511⅛	15340	— 0.19
43	15705.43696	523	15690	— 15.44	523⅛	15705	— 0.44
44	16070.67968	535	16050	— 20.68	535⅛	16070	— 0.68
45	16435.92240	547	16410	— 25.92	547⅛	16435	— 0.92
46	16801.16512	560	16800	— 1.17	560	16800	— 1.17
47	17166.40784	572	17160	— 6.41	572⅛	17165	— 1.41
48	17531.65056	584	17520	— 11.65	584⅛	17530	— 1.65
49	17896.89328	596	17880	— 16.89	596⅛	17895	— 1.89
50	18262.13600	608	18240	— 22.14	608⅛	18260	— 2.14
51	18627.37872	621	18630	+ 2.62	621	18630	+ 2.62

THE CONSTRUCTION OF THE INTERCALARY CYCLE OF 103 YEARS.—(*Continued*).

Cyclic Years' Duration	Cumulative Days for Duration in Mean Years of Cycle	360 Days' Calendar Year.			365 Days' Calendar Year.		
		Duration on Cycle		Day I Month I Commencing Before (—) or After (+ Beginning of Mean Year of Cycle	Duration on Cycle		Day I Month I Commencing Before (—) or After (+) Beginning of Mean Year of Cycle
		In Months	In Days		In Months	In Days	
52	18992.62144	633	18990	— 2.62	633⅛	18995	+ 2.38
53	19357.86416	645	19350	— 7.86	645⅓	19360	+ 2.14
54	19723.10688	657	19710	— 13.11	657½	19725	+ 1.89
55	20088.34960	669	20070	— 18.35	669⅔	20090	+ 1.65
56	20453.59232	681	20430	— 23.59	681⅝	20455	+ 1.41
57	20818.83504	694	20820	+ 1.16	694	20820	+ 1.16
58	21184.07776	706	21180	— 4.08	706⅛	21185	+ 0.92
59	21549.32048	718	21540	— 9.32	718⅓	21550	+ 0.68
60	21914.56320	730	21900	— 14.56	730½	21915	+ 0.44
61	22279.80592	742	22260	— 19.81	742⅔	22280	+ 0.19
62	22645.04864	754	22620	— 25.05	754⅝	22645	— 0.05
63	23010.29136	767	23010	— 0.29	767	23010	— 0.29
64	23375.53408	779	23370	— 5.53	779⅛	23375	— 0.53
65	23740.77680	791	23730	— 10.78	791⅓	23740	— 0.78
66	24106.01952	803	24090	— 16.02	803½	24105	— 1.02
67	24471.26224	815	24450	— 21.26	815⅔	24470	— 1.26
68	24836.50496	828	24840	+ 3.49	828	24840	+ 3.49
69	25201.74768	840	25200	— 1.75	840⅛	25205	+ 3.25
70	25566.99040	852	25560	— 6.99	852⅓	25570	+ 3.01
71	25932.23312	864	25920	— 12.23	864½	25935	+ 2.77
72	26297.47584	876	26280	— 17.48	876⅔	26300	+ 2.52
73	26662.71856	888	26640	— 22.72	888⅝	26665	+ 2.28
74	27027.96128	901	27030	+ 2.04	901	27030	+ 2.04
75	27393.20400	913	27390	— 3.20	913⅛	27395	+ 1.80
76	27758.44672	925	27750	— 8.45	925⅓	27760	+ 1.55
77	28123.68944	937	28110	— 13.69	937½	28125	+ 1.31
78	28488.93216	949	28470	— 18.93	949⅔	28490	+ 1.07
79	28854.17488	961	28830	— 24.17	961⅝	28855	+ 0.83
80	29219.41760	974	29220	+ 0.58	974	29220	+ 0.58
81	29584.66032	986	29580	— 4.66	986⅛	29585	+ 0.34
82	29949.90304	998	29940	— 9.90	998⅓	29950	+ 0.10
83	30315.14576	1010	30300	— 15.15	1010½	30315	— 0.15
84	30680.38848	1022	30660	— 20.39	1022⅔	30680	— 0.39
85	31045.63120	1034	31020	— 25.63	1034⅝	31045	— 0.63
86	31410.87392	1047	31410	— 0.87	1047	31410	— 0.87
87	31776.11664	1059	31770	— 6.12	1059⅛	31775	— 1.12
88	32141.35936	1071	32130	— 11.36	1071⅓	32140	— 1.36
89	32506.60208	1083	32490	— 16.60	1083½	32505	— 1.60
90	32871.84480	1095	32850	— 21.84	1095⅔	32870	— 1.84
91	33237.08752	1108	33240	+ 2.91	1108	33240	+ 2.91
92	33602.33024	1120	33600	— 2.33	1120⅛	33605	+ 2.67
93	33967.57296	1132	33960	— 7.57	1132⅓	33970	+ 2.43
94	34332.81568	1144	34320	— 12.82	1144½	34335	+ 2.18
95	34698.05840	1156	34680	— 18.06	1156⅔	34700	+ 1.94
96	35063.30112	1168	35040	— 23.30	1168⅝	35065	+ 1.70
97	35428.54384	1181	35430	+ 1.46	1181	35430	+ 1.46
98	35793.78656	1193	35790	— 3.79	1193⅛	35795	+ 1.21
99	36159.02928	1205	36150	— 9.03	1205⅓	36160	+ 0.97
100	36524.27200	1217	36510	— 14.27	1217½	36525	+ 0.73
101	36889.51472	1229	36870	— 19.51	1229⅔	36890	+ 0.49
102	37254.75744	1241	37230	— 24.76	1241⅝	37255	+ 0.24
103	37620.00016	1254	37620	0.00	1254	37620	0.00

TABLE IV.

THE SERIES COMPRISING THE PERIOD OF THE CYCLE OF 721 YEARS.

No. of Series.	Interval in years.	Cumulative Years.	Intercalary year of Table II. equivalent to Year of Series.	Subtraction of periods of 103 years' cycles from cumulative years of series to obtain year in preceding column.
				120 cumulative years of series.
				Deduct 103 =1 primary solar cycle.
(1)	120	120	17	17 Year of Tables II. and III.
				240 cumulative years of series.
				Deduct 206 =2 primary solar cycles.
(2)	120	240	34	34 Year of Tables II. and III.
				360 cumulative years of series.
				Deduct 309 =3 primary solar cycles.
(3)	120	360	51	51 Year of Tables II. and III.
				480 cumulative years of series.
				Deduct 412 =4 primary solar cycles.
(4)	120	480	68	68 Year of Tables II. and III.
				601 cumulative years of series.
				Deduct 515 =5 primary solar cycles.
(5)	121	601	86	86 Year of Tables II. and III.
				721 cumulative years of series.
				Deduct 618 =6 primary solar cycles.
(6)	120	721	103	103 Year of Tables II. and III.

¶ 30. THE EARLIEST KNOWN EXAMPLE OF THE ALMANAC TRADITION.

Now we saw that in the celebration of the festival of the dead, the 17th day of the Egyptian fixed Agricultural (November) year appeared as an alternative dating to the 1st day of the fixed agricultural year which began on 1st November. From this it would appear that, originally, the 17th day of the second month of the Calendar year of Genesis was commemorated as the 1st day of the first month of the early Egyptian Calendar year, and that, at a later date, the persistence of the tradition, connecting the festival with the 17th day of the month, led to the adoption of the alternative Egyptian dating.

Hypothesis that the 17th day of Genesis Calendar Month II was originally adopted in Egypt as Day I Month I of the Agricultural Year.

This would identify early Egyptian Day I Month I on November 1st, with Day 17 Month II of the Calendar year of Genesis.[1] Day I Month II of the then current Calendar year of Genesis would therefore fall on October 16th (Gregorian), and, in consequence, Day I Month I of Genesis on September 16th (Gregorian). This would mean that the Calendar year of Genesis was an intercalated year of 360 days intercalated with respect to the Autumnal Equinox, which agrees with the data concerning the basis of the Biblical year prior to the Vernal Equinoctial basis of the luni-solar year adopted at the Exodus of Israel from Egypt.

Adoption implies that Genesis Calendar Year was an intercalated Year of 360 days based on Autumnal Equinox.

If this hypothesis is correct—and it is little more than a hypothesis until it is confirmed by reliable data—then the Great Pyramid's 1st November phenomena form the earliest known example of what is understood in modern times as " The Almanac Tradition."

The Pyramid's 1st November phenomena the earliest known example of " The Almanac Tradition."

¶ 31. THE CYCLES OF THE INTERCALATED CALENDAR YEAR.

In Section II of this Chapter—¶ 56—it is shown that both the Calendar year of 360 days and the Calendar year of 365 days in early Egyptian times received intercalations at the end of every five or six years. A series of such intercalary periods naturally fall into a cycle of 103 years of 365.24272 days, giving the mean value of the solar year over the entire period of astronomical time covered by historical records. (Section II, ¶ 56). Table II shows the construction of the cycle. The progressive durations of the years tabulated are for progressive intercalary years of cycle only. The Calendar of 360 days began on the same day as the Calendar of 365 days at the end of each intercalary period of Table II. The intercalary periods of Table II, as will be seen, are all in exact numbers of months of 30 days. Table III gives the comparative details for each year of the Cycle of 103 years. It will be shown later that this cycle and its intercalary periods were observed by the early Egyptians, had been derived from an earlier civilisation, and were still referred to in the early centuries of our Era.

The intercalated Calendar Years of 360 and 365 days coincided every five or six years.

A series of such intercalary periods automatically supplied a cycle of 103 Solar Years.

Tables II and III.

The Cycle used in earliest times ; referred to in latest times in Egypt.

[1]This hypothesis, it will be found, requires a slight revision later.

¶ 32. THE CYCLIC SERIES OF THE 721 YEARS' PERIOD.

The Auxiliary Series,
(1) 120 Years
(2) 120 ,,
(3) 120 ,,
(4) 120 ,,
(5) 121 ,,
(6) 120 ,,
721 years.

7 Cycles of 103 Years.

Series follows intercalations.

An important auxiliary series of cycles dependent upon the intercalary periods of Table II, was a series of six cycles terminally coinciding with seven cycles of Table II, after the duration of 721 years. The auxiliary series consisted of four initial periods of 120 years each terminating at an intercalation of Table II, followed by a period of 121 years ending at an intercalation of Table II,—the 120 years not fulfilling this requirement—the terminal period, making up the six repetitions of the auxiliary cycle, ending at the last intercalation of Table II. Table IV indicates how the auxiliary series was automatically obtained.

In following the years' duration of the 360 *days' Calendar* in Table III, and its successive repetitions, each period of 120 years included four periods of 30 years of the following total duration :—

The included periods of 30 years.

30	years =	365	months of	30 days.
60	,, =	730	,,	,,
90	,, =	1095	,,	,,
120	,, =	1461	,,	,,

The necessary exception was the last 31 years' period of the 121 years of No. (5) of series in Table IV, which automatically followed the rule requiring the interval of the series to end at an intercalation.

Egyptian time measures translated numerically into linear measures.

The Cyclic Dimensions of certain underworld domains.

3 Cycles of 103 × 1 Cycle of 120.

The identities employed by the Egyptians in translating the numerical values of time measures into linear measures will shortly be seen. When this fact of the mythological basis of Egyptian civil and religious life is appreciated it will be understood why certain domains of the Egyptian Underworld are expressed as 309 *ātru* in length, and 120 *ātru* in breadth,[1]—numerically three cycles of 103 years and one cycle of 120 years respectively, indicating the connection understood as holding between the two cycles.

¶ 33. OTHER AUXILIARY CYCLES.

Other important cycles, dependent upon the 103 years' cycle of Tables II and III are :—

I. Commencing from zero year of Table III and following its successive repetitions :

The Cycle of 658 years, (360 and 365 days' Calendar.)

(a) An important cycle of 658 years of 365.2431611 days on the 360 days' Calendar basis and on the 365 days' Calendar basis.

The Cycle of 329 years, (365 days' Calendar).

(b) An important cycle of 329 years (half of above cycle) of 365.2431611 days on the 365 days' Calendar basis.

These two are the most important cycles in Egyptian chronology, and will be found frequently referred to in the Egyptian records.

[1]Budge, "Gods of the Egyptians," vol. I. p 20x

II. Commencing from year 5 of the initial 103 years cycle (on 360 days' Calendar basis) :—

(a) A series of 200 Julian years.
(b) A series of 120 Julian years.

} These agree and terminate exactly at the completion of 35 cycles of 103 years.

Cycles of 200, 120, 97, and 2920 years, commencing after 5 years' duration of initial 103 Cycle.

(c) A series of 97 years of 365.2577 days each closely approximating to the mean siderial year of 365.25637 (modern value).

(d) A cycle of 2920 Julian years, equal to two cycles of 1460 years, beginning at year 5 of the initial cycle of 103 years, and terminating at a year 2925 of the 103 years' cycle in continued repetition.

The most important cycle of these is that of 97 years as it is the one of the above four most often met with in Egyptian cyclic chronology.

The importance of the 97 years' cycle.

¶ 34. THE SED FESTIVAL AND THE SEP TEP SED FESTIVAL.

The series of ¶ 32 confirms Petrie's identification that the Egyptian period of the *Sep tep sed* Festival was an astronomical period of 120 years, and that the period of the *Sed* Festival was an astronomical period of 30 years. Four repetitions of the *Sed* Festival period were celebrated by the *Sep tep sed* Festival. *Sed* means *the tail* or *end*, and therefore refers to a Festival celebrated in the last or tail year of the period of 30 years. *Sep tep* means *the chief repetition* or *occurrence*. The *Sep tep sed* Festival was therefore, the *chief occurrence of the tail* or *end* Festival, in the last or tail year of the 120 years' period,[1] or, as ¶ 32 shows, of the 121 years' period once in every seven repetitions of the 103 years' cycle.

The Chief Festival of 120 years.

The Festival of 30 years.

The Tail or End Festival

In early times it was the custom, as will be seen, for the king, at the *Sed* Festival, to appoint his co-regent. The co-regent, then, began the reckoning of his reign from his first year of co-regency, thus dating from the *Sed* Festival. Successive kings, thus appointed in unbroken succession, would always celebrate their second *Sed* Festival in their 30th year of rule from co-regency. So far—for very early times—Breasted's opinion[2] is applicable that a king's *Sed* Festival was celebrated 30 years from his appointment as co-regent. But when Breasted infers from this that the *Sed* period was not an astronomical period and, further, that the *Sed* Festival was always celebrated 30 years from appointment as co-regent, his opinion fails to accord with the facts.

Ancient custom of Kings appointing their co-regent at the Tail Festival.

Breasted's opinion that the custom continued, and that period not astronomical.

Petrie has shown repeatedly that the co-regency theory does not hold during the greater period of Egyptian history. He has repeatedly claimed that the Egyptian evidence fixes the periods of 30 and 120 years as astronomical periods. The data of ¶ 32 now confirm this, in that Petrie's *astronomical* period is now seen to be an important period of a highly scientific series of *Calendar* cycles, based on an accurate determination of the value of the solar year for ancient times.

Petrie's opinion that custom not continued, and that period was astronomical.

This opinion confirmed by new knowledge of cycles.

[1] Petrie, "Researches in Sinai," p. 180.
[2] "History of Egypt" (1919), p. 39.

¶35. THE RITES OF THE SED FESTIVAL.

Egyptian Rites of "Sed" Festival derived from a previous Civilisation.

The *Sed* Festival and its rites were institutions that the early Dynastic Egyptians derived from an earlier civilization. The significance of the *Sed* period we know to be primarily calendric. But as to what was the original nature of the *Sed* Festival rites is a matter that can only be surmised from what we know concerning the ceremonies followed at the Festival during the times of the earliest Dynasties in Egypt.

Early Egyptians believed that the King at "Sed" Festival renewed his Spiritual and Physical Strength from the presence-form of the Dynastic God.

The purpose of the ceremonies at the time of the first two Egyptian Dynasties centred chiefly round the idea of ensuring the continuity of the Dynasty in both a spiritual sense and a physical sense. The king was the representative on earth of the god of his Dynasty. He was supposed to partake of the spiritual strength of his god, and to derive his physical strength from the god. What was believed to be the process of effecting this accession of Divine Power took place at the *Sed* Festival, when the king and his selected co-regent presented themselves before the Shrine of the "presence-form" of the Dynastic god.

¶ 36. THE RENEWAL OF THE KING.

Festival therefore alternatively designated the Festival of Renewal.

The Reigning King renews and the Elected Co-Regent receives the power of the god.

"The King never dies."

"The King is dead, Long Live the King."

The reigning king was believed to *renew* his strength in the presence of the god. Hence the *Sed* Festival was also known as the Festival of *Renewal.* The selected co-regent, as was believed, received, jointly with the reigning monarch, the power from the god's presence. If the reigning king died before the following *Sed* Festival or Festival of Renewal the power of the god continued in his successor. Such seems to have been the idea that formulated this early stage of the kingly doctrine of Divine Right, and of the constitutional formulæ[1] persisting in our own times and kingdom, "The king is dead, long live the king," and "The king never dies, he only demises the throne."

"Sed" Dancing and Running before the Shrine.

David dances before the Ark.

15 "Sed" Periods from New Epoch of Israel.

The divine right was supposed to pass from one Dynasty to another when the god failed to renew the king, or to accept or provide a successor belonging to the family. The king and his co-regent signified their renewal and accession of power by running or dancing before the shrine of the "presence-form" of the god. Similarly David, in the year in which he received the promise of his Everlasting Kingdom, danced before the Ark of the Covenant, in the presence of the Shekinah, when the Ark returned from the Philistines. St. Paul (Acts XIII, 17-23) refers to this Establishing of the Kingdom in connection with the termination of a period of 450 years[2]—obviously a period dating from an Epoch in Israel's history. The period is an interval of fifteen *Sed* periods of 30 years. Can it be that the Biblical evidence here points to the continuance of certain ancient sacred rites and customs as these were understood amongst the Hebrews,

[1]Refer Ferrar Fenton's long note at the end of his translation of the 1st Book of Genesis, "Bible in Modern English" We do not agree entirely with Fenton's theory, but what he says has an important bearing upon this subject of the *Sed* Festival, as well as upon the question of the Antediluvian genealogies with which Fenton's theory deals.

[2]Refer Founding of Solomon's Temple, 480th year from Exodus. Another *Sed* Festival (I Kings, VI, 1). This throws light on the 450 years of Acts XIII, 17-23.

precisely as the Egyptians followed the rites and customs handed on to them by a former civilisation, that had reduced the central idea to the form presented by the rites of the *Sed* Festival in early Egypt ? That this is not improbable is evidenced by the common origin of the Deluge narrative of Genesis and the Egyptian narrative of the Destruction of Mankind, and all the associated Calendar data connecting the month date of the Festival of the Dead with the month date of the Noachian Deluge.

Egyptian Religious Customs developed apart but had a source of origin in common with the Religious Customs of the Hebrews.

¶ 37. THE EPOCHS AND CYCLES OF GENESIS.

The truth concerning the connection inferred between the ancient Egyptian cycles and the customs and institutions belonging to the period of the early chapters of Genesis is seen at once by tabulating the chronology of the genealogies of Genesis, Chapter V. This is as stated in Table V,—"The Antediluvian Dynasties of Genesis V."

The Chronology of the Genealogies of Genesis confirms above.

It is significant that whereas the initial dates (in Column 2, Table V), of the ten genealogical items, Adam to birth of Noah, do not bear any relation to the Calendar Cycles, the ten terminal dates, in Column 3, all fall at the beginning or ending of the last year of one or other of the Calendar Cycles dependent upon the cycle of 103 years. For this reason the years of the chronology are stated in Table V as A.K. or *Anno Kalendarii*.[1]

The Terminal Dates of the Dynasties of Genesis are dates of the Festival of the End, dated with Epoch of Adam as origin

Two of the terminal dates end at the date of the Deluge ending. Of the remaining eight terminal dates, six coincide with the beginning or ending of the last year of a *Sed* period. Five of these belong to a *Sed* series beginning from 0 A.K., and one to a *Sed* series beginning from 622 A.K., the date of the birth of Enoch or Hanok. That this latter date was reckoned as a separate Epoch is proved by the 365 years of Enoch being dated from 622 A.K., and by the 365 years' period ending at 987 A.K., the termination of three cycles of 329 years from 0 A.K. The latter identity accounts for one of the remaining two terminal datings of column 3. The one terminal dating remaining coincides with the commencement of the last year of the twelfth cycle of 103 years from 0 A.K.

One Exception a Cycle of 329 years.

Another Exception a Cycle of 103 years.

We saw that the *Sed* Festival in Egypt was celebrated in the last year of each period. The chronology of the terminal dates of the dynasties of Genesis confirms that the terminal festivals were celebrated in any convenient month of the last year of a cyclic period.

¶ 38. THE CYCLE OF THE HOUSE OF ENOCH.

From Genesis V, 24, in conjunction with the dates in Table V, we discover that the translation of Hanok (Enoch) is dated at the termination of a cycle of 329 years. Later evidence from Egyptian sources will show this cycle to be the hitherto lost Phœnix cycle of Egyptian, Greek, and Roman tradition.

Translation of Enoch at 3 Cycles of 329 years from Epoch of Adam.

The 329 Years Period the Lost "Phœnix Cycle."

[1]The initial "K" for "C" is intentional, to avoid using A.C.

TABLE V.

THE ANTEDILUVIAN DYNASTIES OF GENESIS V.

The House of	Duration of Dynasty from	to	The cyclic significance of the terminal dating.
ADAM	0 A.K.	930 A.K...	Commencement of last year of 31st Sed Festival from 0 A.K. Since 721+210=931 years.
SHETH	130 A.K.	1042 A.K...	14 Sed Festivals (420 years) from Epoch of Enoch at 622 A.K.
ENOSH	235 A.K.	1140 A.K...	Commencement of last year of 38th Sed Festival from 0 A.K. Since 721+420=1141 years.
KENAN	325 A.K.	1235 A.K...	Commencement of last year of XIIth Cycle of 103 years.
MAHALALEEL ..	395 A.K.	1290 A.K...	Commencement of last year of 43rd Sed Festival from 0 A.K. Since 721+570=1291 years.
JARED	460 A.K.	1422 A.K...	Termination of 4 Calendar Cycles of 200 years from Initial Epoch of Enoch, 622 A.K.
HANOK (Enoch) ..	622 A.K.	987 A.K...	Termination of 3rd Phoenix Cycle of 329 years from 0 A.K. Since 3×329=987 years.
METHUSELAH ..	687 A.K.	1656 A.K...	Termination of 20 Sed periods from Epoch of Noah, 1056 A.K. Termination of Deluge and beginning of new era for Egyptian Sed periods.
LAMEK	874 A.K.	1651 A.K...	Commencement of last year of 55th Sed Festival from 0 A.K. The last Sed Festival of the Antediluvian reckoning from 0 A.K. Since 721+721+210 =1652 years.
NOAH	1056 A.K.	1656 A.K...	The last Sed period (20 periods) from Epoch of Noah, 1056 A.K. Termination of the Deluge, and beginning of New Era for Egyptian Sed Festivals.
NOAH (New Era) ..	1656 A.K.	2006 A.K...	A period of 350 years, the duration of Manetho's last Dynasty of Demi-gods; as the interval from the commencement of Dynasty of Adam to the commencement of the Dynasty of Noah, 1056 years, is the duration of Manetho's last Dynasty of gods.

Now the legend of the Phœnix is the story of its translation at the end of the Phœnix period or cycle. The legend of the Phœnix is thus the Egyptian or Greek mythological form of the translation of Hanok (Enoch). In Egyptian, *Pa* as a prefix to a proper name signified " the house of," or the " father of the house of " the individual designated by the proper name. Hence the Egyptian name Grecianised as " Phœnix " was apparently derived down from " Pa-Hanok " or " Pa-Enoch," the name of the father of the House of Enoch. The Phœnix cycle, therefore, is the cycle of Pa-Hanok, the Cycle of the House of Enoch.

The Translation of the Phœnix is the Translation of Enoch.

Phœnix—Pa-Hanok—House of Enoch.

The date for the translation of Enoch, 987 A.K.,—the termination of three Phœnix cycles—is 360,495 days from the cyclic beginning at 0 A.K. Now the summation of 900 years of 360 days and 100 years of 365 days—numerically 1000 " years "—is 360,500 days. From this almost exact coincidence (within five days), obviously originated the tradition identifying the Phœnix Cycle with a period of 1000 years (as Martial, Claudian, Lactantius, and Nonno). Beginning with Herodotus, however, the majority of the Greek and Latin writers reckoned the period at half this duration, or 500 " years." Apparently, then, both traditions originated from the fact that the translation of Enoch is dated in Genesis at 987 A.K., the completion of [900 years of 360 days]+[100 years of 365 days] numerically totalling 1000 " years."

The 987 years' period to Translation of Enoch is the 1000 " Years " period identified with the Phœnix Cycle.

Half this period the alleged Phœnix Cycle of Herodotus—500 years.

¶ 39. THE EPOCH OF ENOCH AND THE EPOCH OF ABRAM.

Tacitus, and other writers, however, mention an alternative duration of 1460 or 1461 " years " for the Phœnix cycle. This obviously originated from the 365 years of the *life* of Enoch. $4\times365=1460$, and $4\times365\frac{1}{4}=1461$ years. The initial 365 (or $365\frac{1}{4}$) years spanning the life of Enoch, begin from 622 A.K. as in Table V. Observe the significance, then, of the following summation.

Alleged 1461 years of Phœnix Cycle.

Period of 1461 years from Epoch of Enoch to Epoch of Call of Abram.

Birth of Enoch	= 622 A.K.
Interval of	1461 years
Hebrew date for Call of Abram	= 2083 A.K.

The initial period again—the *life* of Enoch (Pa-Hanok)—is a " great year " or a year of years, 365 or $365\frac{1}{4}$ years. The Greeks gave the name " Phœnix " to the palm-tree branch, which as a hieroglyphic in Egyptian, denoted the " year "—365 or $365\frac{1}{4}$ days. Thus Horapollo (I, iii) refers to the " Phœnix, the palm branch " as signifying the " year " in Egyptian; (I, xxxiv) to " the phœnix, the bird " as signifying in Egyptian, " a soul continuing a long time here "; or (I, xxxv) " a man returning home after a long time from a foreign land."

The Associated Egyptian Hieroglyphic Meanings Derived from the Story of Enoch.

¶ 40. THE CALENDAR YEAR OF GENESIS.

The Calendar Cycles, then, of the ancient Egyptians and of the early civilisation briefly pictured in the first eleven chapters of Genesis were identical. This confirms the hypothesis of ¶ 30 as to the intercalated Calendar year of

The Early Egyptian Calendar Cycles and the Calendar Cycles of Genesis Identical.

1st Calendar Year of Genesis began at Autumnal Equinox.

Genesis being based on the Autumnal Equinox. Day I, Month I of Genesis therefore began at the Autumnal Equinox in the zero year, 0 A.K., of Genesis. For several thousand years prior to 2000 B.C., the Autumnal Equinox could fall upon one or other of the days 21st, 22nd, or 23rd September (Gregorian)[1]

1655 years to month dating of Deluge beginning.

From Genesis VII, 11, Day 17, Month II, fell in the 600th year from the Epoch of Noah. Being early in the then current year, as indicated by the month numeral, 599 years from the Epoch of Noah terminated at the beginning of Day 1, Month I of the 600th year. The Epoch of Noah is 1056 A.K. (Table V. from genealogies of Genesis Chapter V.) Hence Genesis VII, 11, refers to Day 17, Month II of 1655 A.K.

Autumnal Equinox of Zero Year of Cycles of Genesis fell within 21-23 Sept. (Gregorian).

Now the Calendar year of Genesis is the Intercalated Calendar Year of 360 days, and the cycles of Genesis V are the cycles dependent upon the statement of Table III. The rules of Table III, therefore, apply as commencing Day 1 Month I on one or other of the days 21, 22, 23 September (Gregorian) 0 A.K. If we knew the year B.C. in which 0 A.K. began we could reduce the range to one particular day of the three. The range of three days is, however, sufficient for purposes of identification

Calendar Cycles and Rules give month dating of Deluge within 30th Oct. to 1st Nov. (Gregorian).

Confirms Purpose of Pyramid's 1st November Phenomena and confirms traditional survival in Modern "All Hallow's Eve."

Following the rules suggested, we find that Day 17, Month II in 1655 A.K. fell on one or other of the days 30th or 31st October or 1st November (Gregorian). As the narrative of Genesis places the Noachian Deluge as beginning on Day 17 Month II, 1655 A.K., it therefore gives the commencement of the Deluge on 30th or 31st October or 1st November (Gregorian). This explains the intention of the Pyramid's 1st November Phenomena, and why the Festival of the Dead is universally associated with a date generally ranging from 31st October (All Hallow's Eve or Hallowe'en) to 2nd November, the modern *All Souls*.

[1]In all *precise* Gregorian datings for ancient times, in this work, the datings have been calculated and are not, therefore, merely approximate datings. For such precise datings, the modern (Gregorian) rule of intercalation has been carried back into ancient times, together with the modern months. This was done for purpose of comparison with the solar year. When comparison with the siderial year or with the Sothic (or Sirius) year is required, the same process is adopted by carrying back the Julian year from 1582 A.D.—when it was discarded for the modern Gregorian year. The latter process is that adopted generally in astronomical calculations for ancient times. The single difference in the month datings, of Julian as compared with Gregorian, is that prior to 1582 A.D. the Julian Leap Year occurs every four years without exception, whereas the Gregorian rule omits three Leap years in every 400 years, otherwise following the Julian rule. This reduces to the following for A.D. years :—

Julian Rule :—All years A.D. divisible by 4 are Leap Years.

Gregorian Rule :—All years A.D.—except zero years of centuries—divisible by 4 are Leap Years. All zero years of centuries divisible by 400 are Leap Years. Thus, 1,600 A.D. was a Leap Year, but 1700, 1800 and 1900 A.D. were not Leap Years.

By following the astronomical reckoning of B.C. years whereby

Astronomical	A.D. 1 =	Historical	A.D. 1.
,,	B.C. 0 =	,,	B.C. 1
,,	B.C. 1 =	,,	B.C. 2

and so on,

the same rules can be applied to B.C. reckoning. Unless, however, in the present work, a B.C. year is specifically defined as B.C. year of astronomical reckoning, it refers to B.C. year of historical reckoning.

SECTION I. SUMMARY AND CONCLUSIONS.

¶ 41. CONCLUSIONS CONCERNING ORIGINS.

In what is generally and vaguely referred to as prehistoric times, there existed a highly developed state of civilisation. Much is to be *inferred* concerning the various phases and branches of life and knowledge of this former civilisation. One thing, however, appears to be certain. It came to an end in such a manner that none of its works—except in the form of tradition—remained as a heritage to the civilisation that followed.[1]

A Former Civilisation. Its Landmarks Vanished.

The men who founded the origins of modern civilisation built on the oral traditions brought over from the former civilisation. In conception, co-relation of ideas, and what we may term mental idiom, we find these origins to be already highly developed. In forms of literary and artistic presentation they are, at first, archaic or amateurish in execution. Development, however, was rapid. Thus, of the first three Egyptian Dynasties, Professor Petrie remarks " The rapid rise of art is the most surprising activity of this age..... So soon as the dynastic race come in, there begins the enormous step in art, rapidly developing to perfection within its natural limits."[2]

Oral Tradition spanned the gap, and carried into the new period of civilisation the conceptions, co-relation of ideas, and the mental idiom of the lost arts and sciences.

¶ 42. CONCLUSIONS CONCERNING THE TRADITIONAL CATASTROPHE AND ITS ANNIVERSARY.

According to the traditions from various sources, the former civilisation met with a catastrophic ending. In ancient Egypt, the tradition exists as " The Destruction of Mankind," in ancient Mexico and Peru as " The Destruction of the World," and in ancient Babylonia and Assyria, and in China, as " The Deluge." These traditional accounts, when compared, indicate they are various versions of the Noachian Deluge narrative in the Hebrew Book of Genesis.

The Traditional Accounts of the former Civilisation's Catastrophic Ending.

The day *generally* celebrated throughout the world, in ancient and modern times, as the Anniversary of the Catastrophe, is 1st November, with variation *generally* from 31st October to 2nd November. These represent in modern times, All Hallows' Eve, All Saints' Day and All Souls' Day.

The Anniversary of the Catastrophe 1st November (Gregorian).

The Autumnal Equinoctial year beginning of Genesis, the 103 years' Calendar Cycle of Genesis, the Genesis Deluge year and month date combine to give the Genesis date for the Deluge as one or other of the three days, 30th October, 31st October, or 1st November (Gregorian).

[1]The statues of Easter Island, and some of the titanic rock temples of Asia have been referred to this period. But they tell us nothing, nor is their identification with the period certain.

[2]It must always be remembered, however, that in all stages and periods of civilisation the highest forms exist alongside the primitive and barbarous. Even the best authorities frequently permit themselves to forget this.

¶ 43. CONCLUSIONS CONCERNING THE FIXED CALENDAR YEAR OF EARLY DYNASTIC EGYPT.

Egyptian Calendar and Agricultural Year began 1st November (Anniversary Date).

Great Pyramid's 1st November Phenomena ensured against error.

Calendar Year a Fixed Year during Egyptian Dynasties I to XVI.

At the commencement of Egyptian Dynastic history, the Egyptian calendar year was instituted to begin from the anniversary of what the Egyptians designated the "Destruction of Mankind"—1st November. This coincided with the beginning of the agricultural year. The agricultural year commenced with the sowing season at the beginning of November. In consequence, the first Egyptian Calendar Season was the Calendar Season of Sowing. The outstanding phenomena of the noon reflexions of the Great Pyramid of Gizeh (Dynasty IV) defined the beginning of the agricultural year and the sowing season to all the inhabitants of the Nile Delta, annually on 1st November. The same phenomena on this date defined the Nile Delta as a truly Oriented Quadrant of a circle centred on the Great Pyramid. The Egyptian Calendar year, thus fixed, remained fixed from Dynasty I to Dynasty XVI.

¶ 44. CONCLUSIONS CONCERNING THE CALENDAR CYCLES AND THEIR ORIGIN.

The Intercalary Periods.

Their Natural Cycle of 103 Solar Years.

Connected "Sed" Festival Periods.

Connected Phœnix Cycle of 329 Years.

The Egyptian Calendar year of 360 days, at this time, received, every five or six years, the addition of a month of 30 days. A series of such intercalary periods automatically formed a Calendar Cycle of 103 solar years. This cycle was also the basis of the Egyptian *Sed* Festival period of 30 years, and of the *Sep tep sed* Festival period of 120 years. It was also the basis of the ancient Phœnix Cycle of 329 years. These and other connected cycles were derived by the Egyptians from the previous civilisation, from which they also derived the original form of their *Sed* festival ceremonies.

Originally Dynasties officially ended only at "Sed" Festivals.

The Origin of this in Genesis V.

In effect, the original conception followed made it impossible for a Dynasty to be declared *officially* ended other than at a *Sed* festival. That this was the conception held by the former civilisation is evident from the chronology of the genealogies of Genesis V. In every case the genealogical item ends in the last year of a *Sed* festival period, or in one exception at the end of a cycle of 103 years, and in another, at the end of a Phœnix cycle of 329 years.

Enoch translated at Phœnix Cycle ending. Translation of Enoch originated Translation of Phœnix. Pa-Hanok—Phœnix—House of Enoch.

From the last identity, the Phœnix cycle was seen to be the cycle of Pa-Hanok, the cycle of the House of Enoch; and the translation of the Phœnix to be the mythological aspect of the Biblical translation of Enoch.

¶ 45. PYRAMID REFLEXIONS AND SHADOWS; TEMPLE ALIGNMENTS; AND ALIGNMENTS OF MEGALITHIC MONUMENTS.

Pyramid automatically defines points of Solar Year.

Idea borrowed for Temple Alignments.

The noon reflexions and shadows of the Great Pyramid automatically and accurately defined the principal points of the solar astronomical and the solar vegetation year. This idea of defining a required point of the solar year was borrowed by the Egyptian, Babylonian and Greek temple builders, as Lockyer and Penrose have shown. Instead of reflexions and shadows, they

adopted temple alignments directed to the point of sunrise of the required day of the year. The same idea was borrowed by the Oriental maritime traders and mining specialists who established mining and other industrial colonies in Spain, Portugal, and Britain. Not having time nor the opportunity to adopt the elaborate temple architecture of the contemporary East, and—as the Belgian archæologist, Siret, has shown,[1]—not permitting the aboriginal inhabitants to understand the use of metals and metal tools, they devised the simple yet accurate constructions of the rough stone circle and of the rough stone alignment. As Lockyer has shown, the stone circle was an advance on the stone alignment, as the latter was an advance—by reason of its greater length generally—on the Oriental Temple Axis alignment.

Idea of Temple Alignments borrowed for Megalithic Monuments.

Oriental Colonists in Spain, Portugal, and Britain adopt "Rough" stone constructions intentionally

¶ 46. IS THE PYRAMID A GRAPHICAL EXPRESSION OF NATURAL LAW?

In light of the foregoing conclusions—and having regard to the extreme accuracy of workmanship in the Great Pyramid and the extreme accuracy of its definition of the points of the solar year—it would seem that the Great Pyramid was not built for the latter purpose only. All our conclusions take us back to the origins in the former civilisation. Can it be that the Great Pyramid has something to tell us concerning these origins, and concerning the basis of the lost sciences and arts of the past?

Other possible purposes of the Great Pyramid?

Lost Sciences and Arts of the Past?

The mathematical or astronomical reader may possibly have seen the clues that have suggested these questions. In the Great Pyramid we have four sloping surfaces at the same angle of slope, accurately oriented, and built at a selected latitude. These comprise four constants.

The Mathematical Clue of the Four Pyramid Constants.

We could understand the two structural constants having been purposely brought to a selected latitude and there oriented to enable the noon phenomena to define the 1st of November. But the chances against the same four constants defining the beginning and ending of Summer by a horizontal South reflexion, and the Equinoxes by North-East and North-West directions, are so overwhelming as to be deemed impossible. Yet the Equinoctial phenomenon and the phenomenon of the beginning and ending of summer, both resulting from the same simple combination of constants, prove the phenomena to have been intentional. Three precise series of independent coincidences of such a nature cannot happen by chance.

Mathematical Authority against the Identities, viewed as resulting from ordinary combination of factors.

Precision of Identities declares against chance and ordinary combination.

Now there is only one class of phenomena that can supply several such striking coincidences and identities from a simple combination, and that is the class of phenomena governed by Natural Law. Of a like simplicity to the case considered are the phenomena whose laws are expressed by the simple natural laws of Newton, Kepler, and Einstein.[2]

Within the Category of Natural Law Phenomena.

Analogy: Laws of Newton, Kepler, Einstein.

[1] D. A. Mackenzie, "Early Man in Britain," pp. 97 and 98.

[2] The statement of Einstein's *Law of Relativity* is simple. What is difficult is the *explanation* of its application in the various branches of science. The same difficulty will be experienced in regard to the Pyramid's application. The simplicity is obvious. Why it should be so is not obvious.

¶ 47. THE PYRAMID DESIGNER'S KNOWLEDGE OF ORBITAL MOTIONS.

Great Pyramid's Noon Phenomena are remotely derived functions of the Primary Functions of the Elements of the Earth's Orbit and its Motions.

Tentatively, therefore, we may accept as possible that the Great Pyramid is the solid geometrical expression of a natural law, or of certain natural laws known to a former civilisation, and that this expression refers to solar astronomical time, and hence, possibly, to orbital motions and elements. The possibility more nearly approaches certainty when the mathematician realises, as he must, that the outstanding noon phenomena of the Pyramid cannot be other than functions that are remote derivatives of other functions. These other functions can only be primary functions of the elements of the Earth's orbit and its motions.

The Relation between the Primary and Derived Functions necessarily known before Pyramid's Simple Expression of the Derived Functions could be evolved.

Obviously it was known, before the Pyramid design was put into being, that certain properties of the solar year could be reduced to the simple Pyramid expression of them. The knowledge of the simplicity of expression necessarily presupposes knowledge of the properties thus simply expressed. The possession of such knowledge by the Pyramid designer implies the possession of a knowledge of astronomy at least equal to that of modern times.

Such Knowledge at least equal to astronomical knowledge of Modern Times.

It may seem rash to suggest such an hypothesis thus early in our argument, but we are content to let the Pyramid's own evidence, and the evidence from archæological and literary sources, speak for themselves. The evidence from these sources has not hitherto been co-ordinated in this connection, but this will be accomplished in subsequent chapters, and the results of this co-ordination fully discussed.

The Direction of further Inquiry.

SECTION II.—ACCESSORY.

¶ 48. THE XVIIITH DYNASTY VAGUE CALENDAR YEAR.

It is an undisputed fact that during the entire duration of the XVIIIth Dynasty of Egypt, the Egyptian Calendar year consisted of 365 days without any intercalation. In other words, the Egyptians of this period had no equivalent for our Leap Year. This form of year is known as the Egyptian Vague (or Wandering) Year. It is so called, obviously, from the fact that it slips back round the Julian year of 365¼ days, at the rate of one day in four Julian years. The slip back amounts to one complete Calendar year of 365 days in 1460 Julian years. At this time the vague Calendar year began with Day 1, Month I, of the now *mis-named* Calendar Season of Sowing.

The Vague or Wandering Year in use during Dynasty XVIII without revision.

¶ 49. THE VAGUE CALENDAR YEAR FROM 6TH CENTURY B.C. TO 3RD CENTURY A.D.

It is also a fact beyond dispute that the vague *Calendar* year of 365 days was in use by the Egyptians from the 6th century B.C. to the 3rd century A.D. It continued in use even after 25 B.C., when the fixed Alexandrian (Julian) year was adopted for Egypt. The evidence concerning all this is too reliable and too surely established to require repeating. At this time, also, the vague Calendar year began with Day 1, Month I, of the now *mis-named* Calendar Season of Sowing.

The Vague or Wandering Year in use 6th Century B.C. to 3rd Century A.D. without revision

¶ 50. BETWEEN DYNASTY XVIII AND THE 6TH CENTURY B.C.

The evidence is also very complete that, between the period of Dynasty XVIII and the 6th Century B.C., a vague year was in use, with Month I of the so-called Calendar Season of Sowing as the first month of the Calendar year. But as to whether or not the vague year during this interval continued its tranquil *wandering* unaffected by legislation or other means of revision is a question that has failed to receive the critical treatment warranted by the evidence.

Vague Year in Use in Period Dynasty XVIII to 6th Century B.C.

But question as to whether subjected to revision.

¶ 51. EVIDENCE POINTING TO TWO REVISIONS.

The evidence indicates that the vague year was twice subjected to revision during the interval defined. It points to a first revision during the reign of Ramessu II (Dyn. XIX), and to a second revision during the reign of Uasarkon II (Dyn. XXII). The indications are that the first revision belongs to the 27th year of Ramessu II, and the second to the 22nd year of Uasarkon II.

Reference to Revision by Ramessu II and Revision by Uasarkon II

¶ 52. THE EFFECT OF THE REVISIONS.

Neither of these revisions effected any considerable displacement of the Calendar year. But they so completely broke the uniform rate of the vague year's wandering that the solution of the astronomical chronology of the Dynasties is a considerably more complicated matter than has hitherto been supposed.

The Two Revisions of the Vague Year considerably complicate Egyptian Chronology from Dynasty XVIII to 9th Century B.C.

The data concerning the two revisions are deep rooted in the Egyptians' own presentation of their history. For this reason, consideration of the evidences will be given only as the various items of the data arise, and for the same reason, cannot be completed within the present volume.

The two regnal years are now, however, stated as an introductory basis of reference for the various items of the data as they emerge.

Vague Year Unaltered from Late in the 9th Century B.C. to the Middle of 3rd Century A.D.

The date of the revision of Uasarkon II determines that the vague year continued its unbroken uniform rate of slip backwards round the Julian year —in spite of other two attempts at revision[1]—from late in the 9th century B.C. to the middle of the 3rd century A.D.

¶ 53. THE ASSUMPTIONS COMMONLY MADE.

The following assumptions have hitherto been made with the utmost assurance :

(1) That the XVIIIth Dynasty vague year continued without revision—*i.e.*, uniformly slipping back without interruption, one day from the Julian year in every four Julian years—during the period intervening to the 6th century B.C. ; and

Common Egyptological Assumption :— Vague Year not subjected to Revision from 5700 B.C. or alternatively from 4240 B.C. to 238 A.D.

(2) That the same uniform rate of wandering had continued without revision or alteration, during the whole period of Dynastic history,—and earlier, from 5700 B.C. or alternatively from 4240 B.C. to 238 A.D. when Censorinus wrote concerning the Vague Year in his *De Die Natalis*.

¶ 54. THE FIXED YEAR OF PERIOD DYNASTIES VI TO XII.

Common Assumption of Unbroken Sequence of Unintercalated Years of 365 Days.

The basis of the common assumption is that the Egyptian Calendar—during the period of Dynastic history—always consisted of an unintercalated Calendar year of 365 days. Much might be said concerning the flaws in this assumption. The comparative charts, diagrams and data of Plates IX, X, and XI, however, render any such discussion superfluous.[2] Here we have the facts concerning the events of the seasons of the solar year compared with all the dated events of the defined seasons of the Calendar year in Egyptian records belonging to the period of Dynasties VI to XII inclusive. This comparison shows that during this period the calendar seasons coincided exactly with the actual seasons from which they derived their names. In other words, during Dynasties VI to XII, the Egyptians had a fixed (intercalated) year beginning at the commencement of the November Agricultural Year.

Recorded facts prove otherwise.

Calendar Year Intercalated during period of Egyptian Dynasties VI to XII.

Reference to Egyptian Data proving a Fixed November Agricultural Year.

[1]Decree of Canopus, 238 B.C., and the Institution of the fixed Alexandrian (Julian) year 25 B.C.
[2]Refer detailed description of these, ¶¶ 73 to 75d.

¶ 55. THE XIITH DYNASTY RECORD OF THE HELIACAL RISING OF SIRIUS.

The first appearance of the Hittites during the reign of Senusert III of Egyptian Dynasty XII, during the reign of Khammurabi, the Babylonian contemporary of Abraham, and during the life of Abraham in Canaan, fixes the date of the beginning of the reign of Senusert III not earlier than 2100-1900 B.C. This fixing of the date is apart from any real or imaginary astronomical fixing.

Hittites' First Historical Appearance fixes Dates of Dynasty XII in Egypt.

For many centuries around this period—*vide* Oppolzer's calculations—Sirius rose heliacally at Memphis on 18th July (Julian) in three out of every consecutive four years, and on 19th July (Julian) in one out of every consecutive four years. From 2100 to 1900 B.C. (astronomical) these dates coincided with 1st July (Gregorian) and 2nd July (Gregorian) respectively. Hence from 2100 to 1900 B.C. (astronomical) Sirius rose heliacally on 1st July (Gregorian) in three out of every consecutive four years, and on the 2nd July (Gregorian) in one out of every consecutive four years.

The Heliacal Rising of Sirius at the Time of Dynasty XII.

Amongst a number of Papyri discovered at Kahun, and belonging to the period of Dynasty XII, were two mentioning the heliacal rising of Sirius in the 7th year of Senusert III. The account containing this notice narrates that on Day 25, Month III, Season Pert (Growing and Harvest), the superintendent of the temple advised the governor that arrangements were being made for the festival of the heliacal rising of Sirius which would take place on Day 16 of the following month. The narrative, continuing in diary form, gives, under Day 17, Month IV, Season Pert, an inventory of the " festival offerings for the rise of the star Sirius " on that date.

The XIIth Dynasty Record of Heliacal Rising of Sirius.

Day 17 of 8th Calendar Month.

The heliacal rising therefore took place on 1st or 2nd July (Gregorian), 226 days after the commencement of the Calendar year. The current Calendar year, therefore began on the 17th or 18th November (Gregorian)—16 or 17 days after the fixed position of the true beginning of the year.

Current Calendar Year began on 17-18th November (Gregorian).

This interval, obviously, indicates why special attention was directed to the Sirius rising in this particular year. In this year Sirius rose heliacally on Day 17 of the 8th Calendar Month, and the first day of the current Calendar year began on Day 17 of the 1st month of the fixed Calendar year, as defined by the Pyramid's 1st November phenomena. Here we find indicated the connection between the two alternative month datings celebrated as the day of the Festival of the Dead. (Refer Sect. I, ¶¶ 28 and 29.)

On 17th Day of 1st Calendar Month of the Fixed Pyramid 1st November Year.

¶ 56. THE FIXED NOVEMBER YEAR OF DYNASTIES I AND II.

Tables II and III have shown that the intercalations of the 360 days' year occurred at intervals of five or six years. The Annals of the early Dynasties, of which the Palermo stone is a considerable fragment, indicate that the Festival of Sokar,[1] (Osiris) occurred after precisely this interval.

Annals of Dynasties I and II give Feast of Sokar (Osiris) occurring every 5 or 6 Years.

[1]Breasted, " Ancient Records," I, pp. 58-63.

Proves Intercalations Adjusting Calendar Year to Fixed 1st November Year.

Now Dr. Frazer ("Adonis, Osiris, Attis") has shown that the Festival of Sokar (Osiris) is identical with the Festival of the Dead. (Refer Sect. I, ¶ 26.) It therefore fell on the 1st November (Gregorian), (refer Sect. I, ¶ 25) which accounts for its celebration once only in every five or six years during the period of Dynasties I and II. The Palermo Stone, therefore, proves that an intercalary cycle kept the Calendar year adjusted to the 1st November year at the time of Dynasties I and II.

Both Calendar Years..360 and 365 Days..thus Adjusted.

The 103 Years' Cycle.

Maspero and Budge, again, have shown repeatedly that the Epagomenal days—"the five days over the year"[1]—were known as early as the beginning of Egyptian Dynastic History. This necessarily implied that the year of 365 days was in use at the same time as the year of 360 days. As the latter was intercalated with respect to 1st November, the former must have been intercalated with respect to 1st November. It follows, then, that the two Calendar years followed the same Calendar Cycle. This is the case with the Calendar cycle of 103 years.

(Refer Tables II and III, Sect. I., ¶ 31.)

¶ 57. THE MONTH NAME REVISIONS FROM DYNASTY XII TO 6TH CENTURY B.C.

XXth Dynasty Fixed Celestial Sothic Calendar.

"Hathor" Name of its 4th Month.

The XXth Dynasty Calendar on the walls of the Temple of Amen at Medinet Habu give the months of the Celestial or Sothic (fixed) year and the month datings of the annual festivals. This has no relation to the contemporary *vague* or *wandering* year. Day 1 Month I begins with the Heliacal rising of Sirius, and Day 1, Month IV of the Calendar is the Day of the Feast of Hathor. The latter proves that *Hathor* was the name of the 4th month of the Calendar (and that *Mesore* was the name of the 1st month) at the time of Dynasty XX.

Period Dynasty XII "Hathor" 4th Calendar Month.

Period Dynasty XVIII "Hathor" 3rd Calendar Month.

9th Century B.C. to 3rd Century A.D. "Hathor" 3rd Calendar Month.

This identification of the names for the Calendar months agrees with the identification for the period of Dynasty XII.[2] It does not, however, agree with the identification of month names for Dynasty XVIII. Hathor was the name of Month III, and Thoth the name of Month I of the Calendar at the time of Dynasty XVIII.[3] This, again, was the identification holding from the end of the 9th century B.C. to the middle of the 3rd century A.D.

3 Calendar Revisions between Dynasty XII and 9th Century B.C.

High Nile dating 3rd Year Uasarkon II.

"It is obvious then, that the Calendar was revised between Dynasty XII and Dynasty XVIII; again, between Dynasty XVIII and Dynasty XX; and again, between Dynasty XX and the end of the 9th century B.C. The latter revision certainly took place after the 3rd year of Uasarkon II, as is proved by the high Nile dating recorded for that year at Thebes. (Refer ¶¶ 48-53). Discussion of this subject will be resumed later.

[1] See also Petrie, "Historical Studies," p. 8.

[2] Petrie, "Historical Studies," II, pp. 8 and 22, and *Ancient Egypt*, 1917, p. 45; revision of "Historical Studies."

[3] Month name identifications on a clepsydra of Amenhotep III, Karnak. *Ancient Egypt*, 1917, pp. 42-45.

¶ 58. THE XXTH DYNASTY CELESTIAL OR SOTHIC CALENDAR.

The XXth Dynasty fixed Sothic Calendar and its datings (¶ 57) are stated in Table VIII. The Gregorian month datings follow from the facts :—

XXth Dynasty Celestial Calendar Dating.

(1) That Dynasty XX certainly began around 1200 B.C.

(2) That around, and for several centuries after 1200 B.C., Sirius rose heliacally three years in every consecutive four years on July 19th (Julian), and one year in every consecutive four years on July 18th (Julian).

(3) That July 18-19 (Julian) coincided with July 7-8 (Gregorian) from 1301 to 1100 B.C. inclusive.

Festival Osiris Sokar.

31st October—1st November (Gregorian) as Dynasties I to XII.

Table VIII shows that the Feast of Sokar (Osiris) was celebrated on 31st October or 1st November (Gregorian). In spite, then, of the contemporaneous vague year Calendar, the XXth Dynasty Egyptians celebrated the Festival of Sokar—the Festival of the Dead—on the same day of the solar year as had been observed during the period of Dynasties I to XII.

¶ 59. THE PTOLEMAIC CELESTIAL OR SOTHIC CALENDAR.

Ptolemaic Celestial Calendar Dating.

Festival Osiris Khent-Amenti.

28th–29th October (Gregorian).

This fixed Sothic Calendar and its festival datings, together with the description of the festival rites of Osiris, as observed in Ptolemaic times, are contained in a long inscription in the Temple of Osiris at Denderah. The essential festivals and their month datings are stated in Table IX. The Gregorian month datings follow from the facts :—

(1) That the inscription belongs to a period between 301 B.C. and 102 B.C. when the heliacal rising of Sirius occurred on one or other of the days July 19-20 (Julian).

(2) That from 301 B.C. to 102 B.C. July 19-20 (Julian) coincided with July 15-16 (Gregorian).

Table IX shows that the Ptolemaic Festival of Osiris Khent-Amenti takes the place of the XXth Dynasty Festival of Osiris Sokar. The Ptolemaic Festival lasted for 18 days—from Day 12, Month IV (October 24-25) to Day 30, Month IV (November 12-13)—" and set forth the nature of Osiris in his triple aspect as dead, dismembered, and finally reconstituted by the union of his scattered limbs. In the first of these aspects he was called Khent-Amenti, in the second Osiris-Sop, and in the third Sokar." The Festival of Osiris Khent-Amenti—the festival of the *dead* Osiris—fell on October 28-29 (Gregorian), a slip of three days being indicated from the original placing still retained in the time of the XXth Dynasty. The slip is accounted for, as will be shown later, by the fact that whereas the later Egyptian astronomer priests (Dynasty XX to Ptolemaic times) reckoned the Sothic year as 365.25 days, they also reckoned the Solar year as 365.24 days, to obtain Precession of the Solar year round the Sothic year once in 36,525 years. The difference between the true solar and the nominal solar year amounted to $2\frac{1}{2}$ to 3 days between 1200 B.C. and 100 B.C.

The Nominal Sothic Year of 365.25 Days

The Nominal Solar Year of 365.24 Days.

Give Precessional Cycle of 36,525 Years

TABLE VIII.

XXTH DYNASTY DATINGS OF ANNUAL FESTIVALS.

Brugsch, "Egypt under the Pharaohs" Vol. II, p. 156.		Gregorian Month Datings, for period 1301-1100 B.C.
New Year's Day, Rising of Sirius	Day 1, Month I	= 8th–9th July.
Feast of Hathor	Day 1, Month IV	= 6th–7th October.
Feast of Sacrifice	Day 20, Month IV	= 25th–26th October.
Opening of the Tomb of Osiris	Day 21, Month IV	= 26th–27th October.
Feast of the Hoeing of the earth	Day 22, Month IV	= 27th–28th October.
Preparation of the Sacrificial Altar in the Tomb of Osiris	Day 23, Month IV	= 28th–29th October.
Exhibition of the Corpse of Sokar (Osiris) in the Midst of the Sacrifice	Day 24, Month IV	= 29th–30th October.
Feast of the Mourning Goddesses	Day 25, Month IV	= 30th–31st October
Feast of Sokar (Osiris)	Day 26, Month IV	= 31st October–1st November.
Feast of Palms	Day 27, Month IV	= 1st–2nd November.
Feast of the Precession of the Obelisk ..	Day 28, Month IV	= 2nd–3rd November.
Feast of the Exhibition of the Image of Did (the symbol of Osiris)	Day 30, Month IV	= 4th–5th November.
Feast of the Coronation of Horus	Day 1, Month V	= 5th–6th November.

TABLE IX.

PTOLEMAIC DATINGS FOR THE OSIRIAN FESTIVAL RITES.

Budge, "Gods of the Egyptians," Vol. II, pp. 128-129. (for Osirian Festival Month Datings).	"Celestial" Calendar Month Datings.	Equivalent Gregorian Month Datings.
"Celestial" New Year's Day, Heliacal Rising of Sirius	Day 1, Month I	= 15th–16th July.
	Day 1, Month IV	= 13th–14th October.
Feast of the Hoeing of the earth	Day 12, Month IV	= 24th–25th October
Festival of *Pert* ("Coming forth" or "growing")	Day 14, Month IV	= 26th–27th October.
Festival of Osiris Khent-Amenti	Day 16, Month IV	= 28th–29th October.
"Model of the god of the preceding year "taken out from its place and buried "suitably, and the new Osiris was "embalmed in the Sanctuary" ..	Day 24, Month IV	= 6th–7th November
Feast of the Exhibition of the Image of Did, the symbol of Osiris	Day 30, Month IV	= 12th–13th November.

In the same period, the nominal solar year had receded from the Sothic year to the extent of ten days. This accounts for the ten days difference between the XXth Dynasty and the Ptolemaic seasonal datings.

Non-seasonal Datings of Two Calendars (Dynasty XX and Ptolemaic) Fixed.

Comparison of the two Calendars (Tables VIII and IX) again, shows that in both XXth Dynasty and Ptolemaic times, the Feast of the Exhibition of the Image of Did was attached to Day 30, Month IV. This indicates that certain festivals were not seasonal and that such festivals remained attached to the day of the month at which tradition of a certain period placed them.

¶ 60. THE NUMERICAL DETAILS OF THE PTOLEMAIC FESTIVAL.

In the Ptolemaic celebration of the Festival, 34 Papyrus boats conveyed 34 images. These obviously were derived from, and symbolise, the 34 intercalary periods of the 103 years' cycle (Tables II and III). From Tables II and III, we observe as follows :—

34 intercalated years of the 360 days' calendar
=34 intercalated years of 365 days' calendar,
=34½ years of 360 days (not intercalated),
=12,420 days=414 months of 30 days each.

The numerical significance of the enumeration here becomes apparent, For, since

$$4 \times 414 \text{ months} = 1656 \text{ months},$$

Numbers Associated with Ptolemaic Ceremonies Give Deluge Date 1656 A.K.

and since the Osirian texts state that "one day counts for a month," so, presumably, one month counts for a year, and therefore, 1656 months symbolise 1656 years. This gives symbolically the date of the Noachian Deluge Ending 1656 A.K., as in Table V.

Similar Babylonian Identity.

A similar numerical identity—giving the Deluge Date 1656 A.K.—was found by Oppert,[1] in the case of the mythical chronology of the Babylonians.

¶ 61. THE HYKSOS CALENDAR RECORD OF AN INTERCALARY CYCLE.

"The Five Days Over the Year."

From the earliest dynastic times, the Egyptians referred to the epagomenal days—the five days over the year—as the birthdays of certain gods and goddesses. These were, respectively, in the order of the days, Osiris, Horus, Set (Typhon), Isis and Nephthys. Now the civil calendar of 360 days was in use from Dynasty I to Dynasty XII at least, in conjunction with the Calendar year of 365 days. At this early period, then, the epagomenal days—the birthdays of the five gods or goddesses—coincided, between intercalary years, with certain five days of Month I, Season of Sowing. Immediately after an intercalation, Day 1, Month I of the 360 days' Calendar would follow the fifth of the Epagomenal days of the 365 days' Calendar. In the second year after an intercalation, Days 1 to 5, Month I, of the 360 days Calendar would coincide with the five Epagomenal days of the 365 days Calendar.

The Birthdays of
1. Osiris,
2. Horus,
3. Set,
4. Isis,
5. Nephthys.

These Birthdays in Relation to Intercalated Calendar Year of 360 Days.

[1] Gött, Gel. Nachrichten. 1877, p. 205.

Now there is precisely such a record as this on the back of the Rhind Mathematical Papyrus.[1] This Papyrus was compiled during the reign of a Hyksos king (Dynasty XV or XVI), and Egyptologists generally believe it to be of an earlier date than Asseth, the last Hyksos king.

Hyksos' Month Datings of Birthdays of the Gods relate to second year after an Intercalation.

The record states as follows :—

" Year 11, Month I, Day 3, birth of Set ; the majesty of this god caused his voice (to be heard)."

" Birth of Isis, the heaven rained."

The record states that the birthday of Set (the third of the Epagomenal days) fell on Day 3, Month I, and that the birthday of Isis (the fourth of the Epagomenal days) followed, obviously on Day 4, Month I. As the coincidence noted always occurred in the second year after an intercalation, it is obvious that the Hyksos record indicates two facts. These are :—

Hyksos Record Proves Fixed Intercalated November Year Continuously Used from Dynasty I to Dynasty XVI.

(1) That in Hyksos times (Dynasties XV and XVI) the intercalated Calendar years of 360 and 365 days—in use from Dynasty I to XII—were still in use at the time of Dynasty XV or XVI.

(2) That such intercalations occurred at the intervals of five or six years found established at the time of Dynasties I and II.

The Hyksos Calendar record on the Rhind Mathematical Papyrus therefore proves, in conjunction with the preceding data, that the fixed November year and the conforming intercalated Calendar years of 360 and 365 days were in continuous use from Dynasty I to Dynasty XV or XVI.

¶ 62. EARLY EGYPTIAN EXAMPLES OF " THE ALMANAC TRADITION."

One point, however, requires to be cleared up. The Hyksos' Calendar record, under " birth of Set," on Day 3, Month I, states that " the majesty of the god caused his voice (to be heard)." This does not mean that thunder was heard on this day in the particular year recorded. Any ancient or modern almanac—by the kind of reference given—will show what is meant. The record is an early example of what we now term " The Almanac Tradition." Almost every Almanac, in any year, gives the anniversary of the Battle of Waterloo. In this case of the Hyksos' record, the day is the anniversary of the day upon which Set, at his birth, first rended the sky (the goddess Nuît) with his thunderbolts. Thus the *Egyptian Book of the Dead*[2] refers to Set as the god who " letteth loose the storm clouds and the thunder in the horizon of heaven." According to Plutarch, Set tore his mother's bowels at birth, Set's mother, Nuît, being the sky goddess.

Set, at Birth caused his Voice (Thunder) to be Heard.

Tradition Annually Recorded on his Birthday.

Similarly, Isis was not only the primitive goddess of grain, but as such, was also the goddess of verdure, moisture and rain, and is referred to as " the wife of the lord of the Inundation, the creatrix of the Nile flood."[3] Her tears for

Heavens Rained on Birthday of Isis.

[1] Petrie, " Historical Studies," II.
[2] Budge, " Gods of the Egyptians," Vol. II, pp. 246-7.
[3] Budge, " Gods of the Egyptians," Vol. II, p. 214.
Moret, " Kings and Gods of Egypt," p. 106.

the dead Osiris were supposed to produce the Inundation. Hence the Hyksos record refers to Day 4, Month I of the current Calendar year as falling upon the anniversary of the "birth of Isis," when "the heaven rained." In this case also, as in the case of Set, we have an early example of the "Almanac Tradition." It is unnecessary, therefore, to point out that the record does not refer to rain falling upon this day in the particular year of the record.

Tradition Annually Recorded.

Hyksos' Calendar Record Not a Dated Record of Thunder and Rain.

This explanation has been rendered necessary owing to the fact that the dates of the Hyksos' Dynasties have been "fixed" from the supposed occurrence of rain on the day and month stated.

Fixing Hyksos' Date on Such Supposition.

¶ 63. THE ESTABLISHING OF THE VAGUE YEAR.

The Egyptian "Book of the Sothis," preserved by Syncellus, states that the vague or wandering year of 365 days was first instituted by the last Hyksos king, Asseth. The statement is :—"This king (Asseth) added the five Epagomenae and in his time they say the Egyptian year was reckoned as 365 days, having before this time counted only 360." Obviously, the statement means that prior to Asseth, the last Hyksos king, the civil Calendar of 360 days was the intercalated year, and that Asseth, who reigned not long prior to Dynasty XVIII, instituted, as the civil year, the unintercalated or vague year of 365 days.

The Last Hyksos King, Asseth, Introduces the "Vague" Year of 365 Days, as the Civil Calendar Year.

Two facts confirm this. These are :—

(1) That from Dynasties I to XV or XVI, according to the evidences discussed, the Civil Calendar year was an intercalated Calendar year, adjusted at intervals of five or six years, to the fixed 1st November Agricultural year.

Confirmed by Proofs of Fixed Year Dynasties I to XVI.

(2) That the month datings for the recorded heliacal risings of Sirius during Dynasty XVIII determine that the vague year was then in use, but had not long prior to Dynasty XVIII, been in its true 1st November-beginning position—with the Calendar Season of Sowing coincident with the actual Season of Sowing.

Confirmed by Vague Year Month Datings of Heliacal Risings of Sirius during Dynasty XVIII.

All the evidences, then, from the period of Dynasties I to XVIII, combine to prove :—

(1) That the year was a fixed November-beginning Agricultural year from Dynasty I to XVI.

Fixed Year Dynasties I to XVI.

(2) That the last king of Dynasty XVI first established the vague or wandering year ; and

(3) That the first Egyptian records, employing the vague year for month datings, are the records of Dynasty XVIII.

Vague Year Dynasty XVII Onwards.

Section III.—Detailed Technical Description of Plates.

Pyramids of Khufu and Khafra.

Sphinx.

Khafra's Granite Temple.

Pyramid Causeways.

Arrangement of Pyramids and Temples to avoid intercepting shadows and reflexions.

¶ 64. FRONTISPIECE. UPPER PERSPECTIVE VIEW. RESTORATION OF THE PYRAMIDS AND TEMPLES OF GIZEH PLATEAU.

The 1st (Great) Pyramid of Khufu (Dynasty IV) is shown on the right, and the 2nd Pyramid of Khafra (Dynasty IV) on the left. In the right foreground appear the Sphinx and part of the Granite Temple of Khafra. Leading from the latter is shown the causeway to the 2nd Pyramid. The similar causeway to the Great Pyramid is shown in the right hand middle distance.

Attention is directed to the fact that none of the larger pyramids are in the line of the Great Pyramid's noon shadows or reflexions, and that the smaller pyramids and temples do not interfere with the projection of these.

¶ 65. PLATE I. PLAN OF STONEHENGE. STONE CIRCLE AND OUTER EARTH CIRCLE.

Reconstructed from Sir William Flinders Petrie's Survey, "Stonehenge," and from data in Mr. Edgar Barclay's "Stonehenge."

Stonehenge Alignment and Date.

The axis line XY is shown as determined by Sir Norman Lockyer from the existing alignment. As calculated by Lockyer, this alignment is directed to the point of Sunrise at the Summer Solstice, 1680 B.C. ± 200 years. The fallen position of the so-called "Slaughter Stone" has nothing whatever to do with the sunrise alignment.

"Slaughter Stone."

Outer Earth Circle and Lockyer's Theory.

The Earth Circle's Agricultural Year.

November 8.

February 4.

Lockyer considers that the construction of the outer Earth Circle was long prior to the erection of the Stone Circle. He dates the Earth Circle about 2000 B.C., and considers from the existing evidence that the agricultural year was in use at that time. Thus, standing at M on the Earth Circle, on left of Plate I, and looking over the upright stone A, in bottom left of Plate I, towards the corresponding upright stone B, on the middle right, gives the alignment pointing to Sunrise at commencement of Winter, November 8th, and end of Winter, February 4th. The alignment AOB passes through O, the common centre of the Earth and Stone Circles.

May 6.

August 8.

Looking in the opposite direction over the upright stones, *i.e.*, from N on the opposite side of the Earth Circle, gives the alignment BOA pointing to Sunset at the commencement of Summer, May 6th, and end of Summer, August 8th.

Earth Circle's Solstitial Alignment.

Standing at P on the Earth Mound, in the middle left of Plate I, and looking over the upright stone A in the lower left, gives the alignment PA pointing to Sunset of Winter Solstice. Looking from Q on the Mound, in lower right of Plate, across the upright stone B, in middle right of Plate, gives the alignment QB pointing to Sunrise of Summer Solstice. The Earth Circle, therefore, was designed to give both the points of the astronomical solar year, as well as the points of the agricultural solar year.

¶ 66. PLATE II. PERSPECTIVE VIEW OF STONEHENGE AT TIME OF SUNRISE OF SUMMER SOLSTICE, 1680 B.C.

Summer Solstice Sunrise View of Stonehenge.

The direction of sunrise is indicated by the direction of the shadows thrown by the upright stones of the Stone Circle.

Uncertainty Concerning "Slaughter Stone."

The so-called "Slaughter Stone" is shown in its present fallen position at the Avenue opening of the Earth Circle. Not enough is known of its object to justify attempt at restoration. It may have been a portion of an Entrance Trilithon, similar to the five large Trilithons shown within the Stone Circle. But conjecture is futile.

Peculiarity concerning one short upright of Stone Circle and original Gap in Lintel Circle.

Attention is directed to the short upright stone of the Stone Circle shown in right foreground. As Mr. Edgar Barclay has shown, the present condition of this stone is as it was quarried and erected. The gap in the Lintel Circle is therefore as originally constructed. The gap may have been left intentionally to permit of the entrance of the two high poles of banners, festoons or other decorations paraded at the celebrations of the rituals of the temple.

¶ 67. PLATE III. MAP OF THE NILE DELTA.

Great Pyramid Meridian Central Axis of Nile Delta.

Accident or Design.

The central axis of the Nile Delta runs due North and South, and is the Meridian line passing through the Great Pyramid of Gizeh. This might be a coincidence were it not for the fact that all the intentional phenomena of the noon reflexions and shadows of the Great Pyramid were symmetrical to the Delta with respect to this Meridian line.

Pyramid's 1st November Phenomena Define Nile Delta.

Thus on 1st November, the Pyramid's East and West noon reflexions each presented a vertical surface of reflexion to the observer North of the Pyramid. These vertical surfaces defined the North-East and North-West directions respectively from the Pyramid's East and West sides. The line of each vertical surface was the continuation of the respective diagonal of the Pyramid's base, and therefore, made an angle of 45° with the central Meridian line. This indicates one of the reasons for the selection of the Pyramid's site. The intention obviously was that the Great Pyramid should appear as the centre of the Quadrant of the Circle that defines the Nile Delta.

Pyramid at Centre of Oriented Quadrant of Nile Delta.

Pyramid's South Noon Reflexion above the Horizontal during Autumn, Winter, and Spring, but below the Horizontal during Summer.

Again, as seen along the central Meridian line at each noon of Autumn, Winter, and Spring, the South reflexion from the Pyramid was thrown high into the air. Rising first above the horizontal at the commencement of Autumn, the elevation of this noon reflexion increased during Autumn, reached its maximum at Mid-Winter, and decreased towards and during Spring, finally falling below the horizontal at the termination of Spring. On the first day of Summer, this South noon reflexion became horizontal.

At Mid-Summer noon the reflexion reached its lowest depression, thereafter becoming less depressed, until it again became horizontal at noon of the last day of Summer.

¶ 68. PLATE IV. MAP OF THE PYRAMIDS, TOMBS AND TEMPLES ON THE PLATEAU OF GIZEH; AND MERIDIAN SECTION THROUGH THE GREAT PYRAMID.

Compiled from Col. Howard Vyse's "Pyramids of Gizeh," Prof. C. P. Piazzi Smyth's "Life and Work at the Great Pyramid," Prof. W. M. Flinders Petrie's "Pyramids and Temples of Gizeh," and Edgar's "Great Pyramid Passages," Vol. I.

The Meridian Section lies along the central axis of the Nile Delta figured on Plate III, and defined as the Pyramid Meridian Line.

In the North-West corner of the Map Plan is figured part of a spur from the Gizeh Plateau. The height of this spur is shown on the Meridian Section. From the data thus given it is seen that the limiting point of the West noon reflexion from the Great Pyramid on

Possible Significance of situation and Level of Spur of Gizeh Plateau to North-West of Great Pyramid.

1st November lay on the spur referred to, and in the same level horizontal plane (practically) as the Pyramid pavement base. From this indication one might expect to find on the spur mentioned some boundary mark or other indication marking the limit of the first November noon reflexion, or some other evidence of this spur having been dressed down, or levelled up, to receive the projection at the level of the Pyramid base. No search, however, for such a boundary mark, or signs of dressing down has yet been made, for hitherto the reasons for its probable existence have not been disclosed.

In any case it is evident that the 1st November West noon reflexion did not extend beyond the spur shown.

Effect of Reflexions projected below level of Pyramid Pavement.

In the case of the East noon reflexion on 1st November it is a different matter. This reflexion was projected on to the lower plane of the cultivated land, and therefore, continued considerably further than is figured on Plate VII. The same remark applies in the case of Plate VIII. The extent of the projection could not, however, alter the surface planes of the reflexions. Hence the *vertical* surface of the East noon reflexion on 1st November continued further in its direction due North-East.

¶ 69. PLATE V. THE NOON REFLEXIONS OF THE SUMMER HALF OF THE YEAR, *i.e.* during the period between the Vernal Equinox and the following Autumnal Equinox.

Equinoctial Noon Reflexions define North-West and North-East Directions.

Fig. A gives plan of the noon reflexions at the Equinoxes, projected on to the plane of the Pyramid's base level. N. S. E. and W. refer to the North, South, East and West. The outstanding feature is supplied by the East and West noon reflexions. One base line of each of these reflexions, DQ for the West reflexion, and AR for East reflexion, runs due North-West and due North-East respectively, from the West and East corners of the Pyramid's South base side, DA.

Fig. a is the elevation of *Fig. A*. In this the South reflexion $T^{I}OT^{II}A$, is elevated as it is, in varying degrees of elevation during Autumn, Winter and Spring.

A Summer Noon Reflexion Alignment forming a line due East to West on Pyramid North Base.

Fig. B gives plan of the noon reflexions at the beginning and ending of Summer. Ten days after the beginning of Summer, and ten days before the end of Summer RBCQ is a straight line—the North base side of the Pyramid produced—running due East and West.

Horizontal South Noon Reflexion at Beginning and Ending of Summer.

Fig. b is the elevation of *Fig. B*. In this the South noon reflexion $T^{I}OT^{II}A$, is horizontal at the beginning and ending of Summer. (Refer last para. of note to Plate III.)

Inclination of Surfaces of East and West Noon Reflexions.

All these diagrams of Plate V show the North surfaces ORB and OQC of the East and West noon reflexions inclined southwards from the observer in the North. This general feature, with varying degrees of inclination southwards, held between 11th February and 1st November of each year.

¶ 70. PLATE VI. NOON REFLEXIONS AT THE SUMMER SOLSTICE.

Fig. C. Plan of Noon reflexions.

North Noon Reflexion Longest, and West, East, and South Noon Reflexions shortest.

BPC is the longest North noon reflexion of the year.
DQC is the shortest West noon reflexion of the year.
ARB is the shortest East noon reflexion of the year.
ATD is the shortest South noon reflexion of the year.
Q and R reach their Southernmost limits.
Fig. c is the elevation of *Fig. C.*

¶ 71. PLATE VII. PYRAMID NOON REFLEXIONS AND SHADOWS.

Variations of East and West Reflexions.

Figs. D and E indicate on plan how the surfaces ORB and OQC of the East and West noon reflexions as seen from the North, gradually lost their inclination towards the South as 1st November approached, when they became vertical and pointed due North-East and North-West respectively, along the Pyramid base diagonals DOB and AOC respectively, produced to R and Q (*Fig. E*).

Their Vertical Surfaces on 1st November and 11th February are Directed North-East and North-West.

The reverse process happened on 11th February, when the surfaces ORB and OAC of the East and West reflexions again became vertical and pointed North-East and North-West respectively. Prior to this date, and since 1st November, these surfaces inclined, with varying degrees of inclination overhanging towards the observer in the North. After the 11th February they again assumed the inclination towards the South.

Appearance and Disappearance, and Variations of North Noon Shadow.

Fig. D shows the Pyramid's North face first appearing in noon shadow at 14th October, but throwing no shadow on the pavement base. On successive noons after 14th October, the shadow, thrown on to the pavement base, gradually extended, reached its Northernmost limit at the Winter Solstice, commenced to creep back after the Winter Solstice, and reached its final stage of coincidence with the North base line on 28th February (as on 14th October), after which it disappeared until the following 14th October.

Fig. E shows the extent of pavement shadow on 1st November.

Figs. d and e are the elevations of *Figs. D and E* respectively.

¶ 72. PLATE VIII. PYRAMID NOON REFLEXIONS AND SHADOWS.

The Peculiarity of the East and West Noon Reflexions during Winter.

The diagrams here are typical of the Winter noon phenomena between 1st November and 11th February. *Figs. F and G* show in plan the surfaces ORB and OAC of the East and West noon reflexions, as seen by the observer in the North, overhanging towards the observer. In both figures the dotted lines on plan, BR and CQ, which lie on the Pyramid pavement base level, are covered or overhung by the sloping surfaces of reflexion ORA and OQD. The figures also show that the same sloping surfaces of reflexion overhang the noon shadow area of the Pyramid's North face slope, BOC.

Figs. f and g are the elevations of *Figs. F and G.*

The Normal Noon Reflexion from South Face Slope 2nd December and 12th January.

Figs. F and f give the noon reflexion and shadow phenomena for 2nd December and 12th January. *Fig. f* shows that on these days the noon reflexion on the Pyramid's South face slope is normal to that surface, *i.e.*, the sun's noon rays are reflected directly back in the direction from which they came. In other words, the angle of incidence = angle of reflection = 0°.

Winter Solstice Noon Phenomena.

Figs. G and g give the noon reflexion and shadow phenomena for the Winter Solstice. R and Q are the furthest Northern limits of the year for the East and West noon reflexions respectively.

V is the furthest Northern limit of the year for the North noon shadow.

T^{1}OAT^{11} (*fig. g*), is the highest elevation of the year for the South noon reflexion.

¶ 73. PLATE IX. CHART SHOWING THE SEASONAL PHENOMENA AND ACTIVITIES OF THE *SOLAR YEAR* IN ANCIENT EGYPT COMPARED WITH THE SEASONAL PHENOMENA AND ACTIVITIES OF THE EARLY EGYPTIAN *CALENDAR YEAR* COMPILED FROM THE DATED RECORDS OF THE PERIOD OF DYNASTIES VI TO XII.

General remarks :—

A New Comprehensive and Comparative Abstract of Fundamental Egyptological Data.

So far as we are aware, this chart is the first comprehensive and comparative abstract of all the known data concerning the relation between the Calendar Year and the Solar Year in the period preceding the XVIIIth Egyptian Dynasty. A careful study of the data of this series of diagrams will well repay both the general reader and the Egyptological

The Bearing of the Abstract upon the question of Egyptian Chronology.

student or expert. For within the bounds of one presentation are given all the scientific data upon which the accepted theory of modern Egyptological chronology stands or falls. The Chart shows that the Calendar Seasons synchronised with the actual Seasons during the period of Dynasties VI to XII, and not only so, but that the *commencement* of the *Calendar* Year at that time synchronised with the *commencement* of the *actual* Egyptian *Agricultural* Year.

As the accepted theory of Egyptological chronology is based on a ***wandering*** Calendar year at that time, the importance of the synchronisms of Plate IX must be evident to everyone giving the matter consideration. So certain is the Chart to tell its own story that we content ourselves with the single assertion, that the data are correctly plotted from all the known facts.

Explanation of Arrangement:—

¶ 73a. NILE FLOW AND HELIACAL RISING OF SIRIUS.

The Solar Year Time Basis of the Abstract.

Column (3) of Plate IX contains the time basis with respect to which all the various data in the remaining columns are arranged. In this column appear plotted to scale of duration in days, the months of the modern (Gregorian) year commencing with November.

Annual Curve of Nile Discharge.

Column (4), as explained on Chart, gives the typical annual curve of Nile Discharge at Memphis.

Heliacal Rising of Sirius. (Gregorian Month Datings).

Inset is the curve of Heliacal Risings of the Star Sirius at Latitude 30° N. The risings are stated with reference to the Modern (Gregorian) month dates reduced from Oppolzer's calculations giving the Julian month dates over the period indicated. (Oppolzer, "Ueber die Länge des Sirius-jahrs und der Sothis periode," Vol. 90, Sitzungsberichte, Vienna Academy). Oppolzer's calculations are extended back to 7171 B.C. by Dr. E. B. Knobel, Historical Studies. (Brit., Sch., Arch., Egypt., 1911, pp. 6 and 7.)

Oppolzer's and Knobel's Calculations.

Oppolzer took the depression of the Sun at the time of the heliacal rising of Sirius as 10° 48′.

Heliacal Rising Defined.

The heliacal rising of a star is its first observed rising after it has been invisible for some time in close proximity to the sun.

XIIth Dynasty Sirius Rising.

Refer description Plate X for XIIth dynasty record of heliacal rising of Sirius.

Annual Curve of Nile Level.

Column (6) gives practically the same Nile flow data as *column* (4), but for gaugings taken 57 years earlier, and stated in terms of Nile level instead of discharge.

Comparison of Nile Data with Data of Herodotus.

These two columns give practically the fluctuations of Nile flow and its range of date variation. These agree with the statement of Herodotus for Memphis in the 5th century B.C. This statement is reduced to graphical comparison in *columns* (4) *and* (6).

Column (5) gives merely an intermediate stage of data in the derivation of *column* (4) data.

¶ 73b. THE ACTIVITIES OF THE YEAR.

Wilkinson's Activities of the Solar Year in Ancient Egypt

Column (7) gives the activities and seasonal phenomena of the *Solar* year in ancient Egypt, at the dates stated by Sir Gardner Wilkinson. These are accepted by all Egyptologists of repute as the reliable basis of this branch of study.

Graphs of Same.

In *Column* (7) the information is reduced to graphical form, diminishing of activity being indicated by the tapering off of areas.

Irrigation, Sowing, Harvest Graphs.

Wilkinson supplies the dates and data for the graphical areas of activity in Irrigation, Sowing and Harvest.

The hot season is known, the tapering off in graphical area representing diminution of heat. **Hot Season Graphs.**

The periods of activity for distant quarrying expeditions depended upon three factors. These are :—

(1) The need for the available labour in sowing and harvest, and to a less extent for irrigation purposes.

(2) The impossibility of efficient quarrying in the hot season. **Distant Quarrying Factors.**

(3) The need in certain cases of utilising the rise of the Nile to float large quarried masses on barges.

These three factors determined the two distant quarrying periods of the year shown in *Column* (7).

¶ 73c. THE DISTANT QUARRYING PERIODS.

The 1st distant quarrying period, then, fell within the months II, III, and IV of the first season of the Agricultural year, *i.e.*, December to February inclusive. It began as sowing operations were finishing. It ended as harvesting became active. This is the principal distant quarrying period, for Sinai, Hat Nub and Hammamat, when High Nile Flood was not required for river transport. **1st Distant Quarrying Period.** **December to February inclusive.**

The 2nd distant quarrying period began towards the end of the hot season, as the Nile began to rise, beginning thus early in order to have the quarried masses ready for the high Nile in September or Early October, and to enable the workmen to return for the middle of the irrigation period at latest, and in time for the early sowing. **2nd Distant Quarrying Period** **Early July to Mid-October**

¶ 73d. IRRIGATION, SOWING, HARVEST, ETC.

Column (8) gives the details of Wilkinson's dated information concerning Irrigation, Sowing, and Harvest. Each item of information is given opposite its place in the modern months as stated by Wilkinson. **Wilkinson's Dates and Data concerning Irrigation, Sowing, Harvest.**

Column (9) gives the same information with respect to the Solar year as column (7). But whereas Column (7) is based on Wilkinson's researches on ancient crops and agricultural activities, independently of the dated records, the areas of activity in Column (9) are plotted entirely from the dated records of the period from Dynasty XVIII to XXX inclusive. During this period the *wandering* calendar year was in use, and it is from the known, or in some early cases the approximately known, position of this wandering calendar year in the solar year at various stages in the period that the modern month datings of the records are found. **Graphs of Activities of Solar Year from Records of Period Dynasties XVIII-XXX** **The Vague or Wandering Year Datings of the Graphs for Dynasties XVIII-XXX.**

¶ 73e. GRAPHS OF YEAR'S ACTIVITIES.

The agreement between the areas of Column (7) and the areas of Column (9) confirms what it was scarcely necessary to confirm, the accuracy of the data based on Wilkinson's Activities of the Agricultural Year. **Agreement of Graphs from Wilkinson's Data and Graphs from Data of Dynasties XVIII-XXX.**

With Columns (1) and (2) we come to the important feature of the charting.

Whereas Columns (7) and (9) give the activities of the *Solar* year in relation to the *modern months* of Column (3), Column (1) gives the activities of the *Calendar* year in relation to the *Calendar months* of Column (2). **Emphasis concerning Graphs from "Solar" Year Datings, and Graphs from Early "Calendar" Year Datings**

It will assist the reader to follow the matter more clearly if he can suppose, in the first instance, that Columns (1) and (2) bear no relation to Column (3).

Necessity for considering the two sets of Graphs, in first instance, as matters apart, and resting solely on their own respective bases.

¶ 73f. THE INDEPENDENT GRAPHS.

Let the reader understand that Columns (1) and (2) are drawn up, independent of Columns (3) to (9), from the early Calendar year datings of the period of Dynasties VI to XII, the areas of activity of the *Calendar* year being stated with reference to Column (2); that Columns (1) and (2), thus attached to each other, were moved into position until the areas of Column (1) were opposite the corresponding areas of Columns (7) and (9); and that when this had been effected it was found that the *Calendar* year and its *Calendar* seasons of the period in question agreed with the actual Agricultural year and its seasons.

The Agreement of the two Sets of Graphs when considered in relation.

Columns (1) and (2), when synchronised with all the data of Columns (3) to (9) prove that the Calendar year at the time of Dynasties VI to XII was a *fixed* Calendar year. In other words, during Dynasties VI to XII, the vague or wandering year was not in use.

Agreement proves a Fixed Calendar Year for period Dynasties VI-XII.

¶ 73g. COLUMN (1), XIIth DYNASTY FLAX HARVEST CALENDAR DATING.

XIIth Dynasty Flax Harvest "Calendar" Dating agrees with actual dating of Flax Harvest.

One important item beginning in Column (1) is the Flax Harvest dating given on a XIIth Dynasty record. (*El Bersheh*, II, Pls. 8 and 9.) The flax harvest is recorded as taking place between Day 23 and Day 27, Calendar Month IV, Calendar Season of Sowing, *i.e.*, 112 to 116 days after the beginning of the Calendar Year. Wilkinson, for ancient times, gives Flax as plucked in Lower and Middle Egypt, late February or early March, *i.e.*, late in the actual Month IV of the actual Season of Sowing, or early in Month I of the actual Season of Harvest.

The Calendar Dating and the actual Dating therefore agree, and the Calendar year began in November.

¶ 73h. COLUMN (1), XIIth DYNASTY HOT SEASON RECORD IN SINAI.

XIIth Dynasty complaint concerning Hot Season Expedition to Sinai.

This is a fine example of an exception proving the rule.

Hor-ur-ra states on record at Serabit, Sinai (reign Senusert III or Amenemhat III):—

Calendar Months of Hot Season agree with actual Months of Hot Season.

"I arrived in this land in Calendar Month III, Calendar Season of Growing (and Harvest), although it was not the season for going to this Mine-land."

".....The highlands are hot in Summer, and the mountains brand the skin..... It is—[*uncertain*]—for it in this evil Summer season."

The Narrative of the Hot Season record.

".....I succeeded in mining the good sort, and I finished in the Calendar Month I, Calendar Season of Inundation. I brought genuine costly stone for the luxuries more than anyone who came (hither).....It was better that the accustomed seasons thereof....." (Breasted, *Records* I, 322, 323).

The Hot Season "Calendar" Months

The hot months here are the 7th, 8th, and 9th months of the Calendar year.

The Hot Season "Actual" Months.

The actual hot months are May, June, and July, respectively the 7th, 8th, and 9th months from November inclusive. This again confirms that the XIIth Dynasty Calendar Year was a fixed November Year.

Data for Graphs.

Plate XI gives a list of all the known VIth to XIIth Dynasty seasonal records used for plotting areas in Column (1), Plate IX.

¶ 74. PLATE X. CHART OF LIMITS OF EARLY EGYPTIAN INTERCALATED CALENDAR YEAR, EGYPTIAN SEASONS, AND GREAT PYRAMID NOON REFLEXION AND SHADOW PHENOMENA STATED WITH REFERENCE TO THE MODERN (GREGORIAN) MONTHS.

The Intercalated Limits of the Early Egyptian "Calendar" Seasons.

The top item of chart—below Scale of Modern Months—represents the maximum and minimum limits of two of the three Early Egyptian Calendar Seasons. The basis of the rule governing intercalation was that the 1st month of the Calendar year (Month I, Calendar Season of Sowing), never began later than 60 days after the Autumnal Equinox. The evidence determining this rule will be given in the various details of same as they are met with in the projected series of volumes. Meantime it is deemed that the practical and simple nature of the rule will appeal to the general reader.

The Rule fixing the Limits.

The other items of the chart, in light of the explanation of the preceding plates explain themselves. It will, however, be noted that the East and West co-ordinates of the East and West Pyramid noon reflexions are equal and always of constant value.

¶ 75. PLATE XI. RECORDS OF THE PERIOD OF DYNASTIES VI TO XII OF DISTANT QUARRYING EXPEDITIONS TO THE QUARRIES AT WADY HAMMAMAT AND HAT NUB, AND TO THE MINES AND QUARRIES OF SINAI.

First Distant Quarrying Period.

The reader will observe that the days of the months are both stated and plotted to the scale of days and months of the Calendar year. From this feature of the charting, it will be seen, for the First Distant Quarrying Period, that only one dating occurs in Month I of the Calendar Season of Growing (Harvest), and only one in Month I of the Calendar Season of Sowing. The others are all concentrated in the period from Day 3, Month II to Day 4, Month IV, Calendar Season of Sowing. This shows clearly enough that the active period began in early December, as irrigation and sowing activities diminished (only one dating occurs before the 15th day of Month II, Calendar Season of Sowing), and ended early February when return for the Harvesting Season was due.

Maximum Activity Mid-December to Early February.

Second Distant Quarrying Period.

The Second Distant Quarrying Period was governed by the requirements as to Nile transport. In some cases it saved time and labour in the handling of large blocks, to utilise the inundation waters for floating off the large quarried masses on shallow barges, then sailing these down the Nile, to navigate the barges over the inundated country, and close up to the building site, before the inundation began to recede from the land.

Maximum Activity Mid-September to Mid-October.

Practise in Later Times.

In such cases, in later times, quarrying began as early as the beginning of July, in the end of the Hot season, for the purpose of having the work ready for floating off over the inundated land to the building site during the extreme height of the Inundation. In discussing such cases, Professor Petrie (*Ancient Egypt*, 1914, p. 91) states, "The hot season work was more usual in later times."

Seasonal Period of Greatest Activity (2nd Quarrying) in Early Times.

For early times, at Hammamat only, there is the single record of Sankh-kara (Dynasty XI), on Day 3, Month I, Calendar Season of Inundation. The other records of the period of Dynasties VI to XII are all concentrated in the second half of Month III, and the first half of month IV of the Calendar Season of Inundation. (Refer Plate IX, comparing these limits, Column (2), with maximum Nile flood, Columns (3) and (4).)

¶ 75a. THE NILE TRANSPORTATION RECORD OF UNA.

Una's statement concerning Nile Navigation conditions.

The Hat Nub record of Una's expedition during the reign of Merenra (Dynasty VI), mentions the quarrying, and then, during 17 days of Month III, Calendar Season of Inundation, the building of the barge, followed by transportation during a second period of 17 days. Una concludes "Although there was no water on the [*thesu*] I landed in safety at the pyramid (called): 'Merenra-shines-and-is-Beautiful'." (Breasted, *Records*, I, p. 149.)

The Reference is to Low-Lying Grounds covered at Inundation.

A statement bearing upon the problem.

The uncertain word *thesu* is generally translated " flats " but as Breasted states, this is " a pure guess." Whatever the word does mean, it cannot apply to any shallows or sand-banks on the normal course of the river itself, but to lowlying grounds off the normal course of the river, and flooded only at high level of inundation. For the same word occurs in a connection that decides against *thesu* applying to shallows on the normal course of the river. This is in an inscription of the reign of Senusert III (Dynasty XII), (Breasted, *Records*, I, p. 300), referring to the celebration of the rites of the Osirian Festival. The inscription states " I championed Uenefer at ' That Day of Great Conflict.' I slew all the enemies upon the ' flats ' (*thesu*) of Nedyt. I conveyed him (the god) into the Barque (called) ' The Great'."

¶ 75b. THE SEASON OF UNA'S ARRIVAL AT MEMPHIS.

Una's arrival when Nile was already receding from Inundated Land.

It is clear then, that the expedition of Una during the reign of Merenra (Dynasty VI), arrived at Memphis when the Nile was already receding from the ' flats ' (*thesu*) there. He had obviously endeavoured to time his arrival at Memphis at highest Nile, but had been delayed by the construction of his barge in 17 days, or else had been unfortunate in having a slightly earlier high Nile than he had anticipated.

Petrie's Original Opinion.

All the other records of the period of Dynasties VI to XII confirm that these are the facts of the case, thus justifying Sir William Flinders Petrie's original opinion in the earlier editions of his " History of Egypt," Vol. 1, p. 95.

Budge's Opinion.

Sir Ernest Budge states, " Petrie argues from this statement that when Una arrived off Memphis in the month Epiphi (Month III, Calendar Season of Inundation), the waters of the Nile had subsided so greatly that he was unable to float the boat or barge with its heavy load over the land which had been recently inundated, for the depth of the water on the land did not permit him to do so. So far all is clear, and this is undoubtedly what the words in the hieroglyphics indicate—but the possibility of deducing any date for the reigning king from this circumstance is too remote to be seriously entertained for a moment." (Hist. Egypt, Vol. 1, 152–3.)

¶ 75c. DEVIATIONS FROM UNA'S NARRATIVE.

The Calendar Month of Una's arrival at Memphis.

One remark in the above calls for comment. The record does not state that Una arrived in Month III of the Calendar Season of Inundation. The month of arrival with his load at Memphis, is not stated. Una merely records that he quarried his stone, and then, in 17 days of the month stated, constructed his barge. In the following 17 days, probably in Month IV of the Calendar Season of Inundation, he came to Memphis, when the Inundation had already commenced to fall, and therefore, at the end of September at the earliest, or mid-October at latest.

How theories can govern the Translating of Records.

The Effect of the discovery of the XIIth Dynasty Sirius Dating.

A revision of Chronology and a revision of the rendering of Una's Record

This long explanation has been rendered necessary by certain revisions of Egyptological opinion following the discovery of the XIIth Dynasty record of the heliacal rising of Sirius. The revisions are not due to any new light upon the inscription of Una, but due to the revision of the Sothic year theory of chronology, based on the theory of an uninterrupted vague Calendar year from the earliest times. The theory of one school—that of the long chronology—makes the date of Merenra as 4190 B.C. The theory of the short chronology gives the date of Merenra as 2570 B.C. The former requires the arrival of the expedition of Una at Memphis to have been at the end of April, whereas the latter requires the end of March. Both cases are in the height of the Harvest Season.

¶ 75d. LOCAL AND DISTANT QUARRYING.

The Local Quarrying Calendar Datings of Dynasty III.

We adhere to Petrie's original identification of the seasons for long distance quarrying expeditions, as that identification is free from the subsequent bias of the Sothic year chronological theory. In this connection the reader must understand that *local* quarrying dates are not included. Local quarrying, *i.e.*, quarrying adjacent to building sites, could

be carried on by small parties at any season of the year. Thus the dated stones of Seneferu's Meydum Pyramid (year 17), range from Day 22, Month II, Calendar Season of Growing and Harvest, to Day 8, Month III, Calendar Season of Inundation. With the fixed November year, this gives a local quarrying period beginning in the end of April, when harvest activities diminished, to the beginning of September, when irrigation operations became active, and, following which, early sowing commenced. (Petrie, Historical Studies, pp. 10–11.)

Local Quarrying suspended during Harvest, but continued during Hot Season.

This shows that *local* quarrying was carried on in the hot weather—the workmen probably slackening off during the heat of the day—but not during Sowing or Harvest.

Proves a Fixed Calendar Year for period Dynasties III to XII.

Seneferu's local quarrying dates, therefore, confirm the fixed November Calendar for the time of the IIIrd Dynasty.

In the case of long distance quarrying, large working and carrying parties, accompanied by a military escort, were supplied. The numbers necessary were not available during Sowing and Harvest, and such long distance expeditions were not undertaken during the hot weather. An exception to the latter case is the expedition of Hor-ur-ra, whose record refers to the exceptional circumstances, and the hardships incidental thereto. (Refer ¶ 73h.)

Labour and Military Escorts for long distance quarrying expeditions.

¶ 76. PLATE XII. THE GEOMETRY OF THE GREAT PYRAMID'S NOON REFLEXIONS AND SHADOWS.

The East and West Noon Reflexions.

Figs. A_1, A_2, A_3, and A_4 are those needing most explanation, as the basal geometry of the East and West Noon reflexions is not an easily comprehended matter.

Fig. A_1 gives the simplest aspect of the West Noon Reflexion. Supposing the Sun could be directly over the Pyramid at noon, Fig. A_1 would represent the precise approach of the sun's ray and the reflexion of the ray from the Pyramid's West Face. This would be for an altitude of the Sun of 90°, which the sun never has at the Great Pyramid's latitude. In such case the reflected ray seen in plan would be directed due West. (Fig. A_2.)

East and West Reflexions for "Supposed" Noon position of Sun at Zenith.

For lower altitudes, however, Fig. A_1 gives precisely the noon conditions as they would be seen by an observer—*i.e.*, the reader looking at the view given—standing in the North and looking towards the Pyramid in the vertical plane of approach of the Sun's ray shown. However low the Sun at noon, the ray would always appear vertical, and the reflected ray would always appear at the same angle from the West face. As seen in plan, however, the lower the noon sun, the more would the reflected ray be swung round from West towards the North. (Fig. A_2.)

How East and West reflected Noon Rays would be seen from the North by an observer on the Pyramid Meridian.

We can sum up in the following statement:—

For a particular point on the West Face Slope of the Pyramid, the successive lines, traced out by the Sun's noon ray to that point on successive noons of the Solar year, lie in a vertical plane running due North and South, and the successive lines traced out by the noon reflected rays from the same point on successive noons of the year lie in a plane inclined 13°.42′ 28″.6 below the horizontal. (Fig. A_1.)

The constant Plane of the East and West Noon Reflexions.

Fig. A_3. XA is a typical Sun's noon ray to the point O on the West face slope of the Pyramid. The vertical plane of all such successive noon rays is the plane XAOBS.

OGFH is the constant plane of reflexion defined above, and shown in elevation in Fig. A_1, depressed at the constant angle of 13°.42′ 28″.6 below the horizontal. The horizontal plane in Fig. A_3 is OBPN. The Constant angle ψ between the two planes is represented by NOM.

Whilst the Plane of Reflexion (for East and West Noon Reflexions) is constant, and the East or West Co-ordinate respectively is constant, the Lower the Sun's altitude becomes at Noon, the more the East or West Noon Reflexion veers round towards the North

XAO is the path of the Sun's noon ray for a particular day. The plane normal to the Pyramid's West Face Slope containing the Sun's noon ray XAO is the plane AOE. The angle of incidence with reference to the West Face Slope is, therefore, the angle AOE. The angle of reflexion must lie in the same plane continued. Hence AOE and OFL lie in the same plane, normal to the West Face Slope, and hence FOL is the angle of reflexion for the noon considered.

It is obvious, also, that DOC and KOH lie in the same plane, *i.e.*, the East and West vertical plane through the point O; that DC = HK and OD = OK; and OC = OH; and that OB = OG = DE = LK.

Fig. A_4 is a detail extracted from figure A_3, with the horizontal plane OBPN continued over the Constant Plane of Reflexion OHGF. A few minutes consideration will now enable the mathematical reader to connect the data of the four figures, A_1, A_2, A_3 and A_4, and to derive the relationship Tan $\hat{D}$ = Tan $\hat{C}$.Cos ψ, from which the various dated phenomena have been derived for the East and West Faces.

The data for the East Face are, of course, identical with the data for the West Face.

Fig. B. This figure for the North and South Faces, is deemed to explain itself to the mathematical reader. It depends entirely upon the relationship :—

Angle of Reflexion = Angle of Incidence.

Fig. C. As above in case of South Face, but for the case of North Face noon shadows, the data depend upon the relationship :—

Sun's noon Altitude = Altitude of plane containing shadow from North Face of Pyramid.

¶ 76a. THE FUNCTIONS OF ATMOSPHERIC DUST.

Dry Atmosphere and large numbers of particles of atmospheric dust render reflected beams of light visible.

The investigations of Mr. John Aitken (Quart. Jour. Roy. Met. Soc., July, 1896; Enc. Brit., 11th Ed., Vol. viii, pp. 713-715, Vol. xviii, pp. 278-279) into the phenomena and climatic effects of atmospheric dust have an important bearing upon the question of the Pyramid's noon reflexions being rendered visible. Aitken's observations have shown that for a dry atmosphere the transparency, brightness, and blueness of the sky—and in consequence, the tendency towards a beam of reflected light becoming visible—increase with the number of particles of atmospheric dust per unit volume of the atmosphere. In the case of a humid atmosphere he shows that for a given number of dust particles per unit volume of atmosphere, the density of the haze in the atmosphere increases as the degree of humidity increases. This is effected by the humidity *condensing* upon the dust, and increasing the size of the particles.

But humid atmosphere produces haze in density increasing with number of dust particles.

Minute size of many of the dust particles.

Too small to settle through the atmosphere.

Surcharged Accumulation of these prevented by wind and rain.

Purifying processes and areas.

Sand Dust driven from African Deserts into Europe.

Many of the dust particles are too small to be precipitated through the atmosphere in dry regions. For this reason, the atmosphere in dry regions would tend to become surcharged with the accumulation of the finer dust particles, were it not for the purifying processes of wind and rain. Driven from the dry accumulating regions into regions of humidity, the dust particles are weighted by the condensation of the atmospheric vapour, and are thus ultimately precipitated through the atmosphere in the form of rain. Aitken defines such regions of discharge as purifying areas for excess atmospheric dust. He states that "there is good reason for supposing that large quantities of sand are carried from the deserts by the wind and transported great distances, the sand, for instance, from the desert of Africa being carried to Europe." Thus he shows that the number of particles for inhabited areas and for the Sahara are high compared with the number of particles in mountain and sea zones, unless when these are being traversed by dust laden currents of air hurrying to a humid zone for discharge.

¶ 76b. CONDITIONS GOVERNING REFLECTED BEAMS BECOMING VISIBLE.

The dry climate of Egypt and the large number of dust particles present in the atmosphere favourable for rendering visible the Pyramid's noon reflexions.

From these observations it is evident that the dry atmosphere of Egypt, closely adjacent as it is to the deserts on the East and West, must have a greater number of particles of atmospheric dust even than most dry climates. There should, therefore, be a greater tendency towards reflected beams of light being rendered visible in Egypt than in more humid climates, or in dry climates where the density of atmospheric dust is lower. That such is the case is clear from the following authentic observation. The description is extracted from a letter to us by Capt. F. A. Whitaker, R.E.—late Chief Instructor, 5th (and later 4th) Army Signals, B.E.F.

An authentic observation confirming this.

"At the time of which I write I was Brigade Signal Officer to the 92nd Infantry Brigade and our Headquarters were established in a hollow between sandhills about five miles East of Ballah on the Suez Canal.

This place, at the time, was the Railhead, and named Ballybunion after the Birthplace of the Engineer who constructed the Railway.

Our front line was situated about a mile further East and was held by the 11th and 13th East Yorks on the Left and Right Sectors respectively. In maintaining communications with the forward Infantry and our base on the Canal, considerable difficulty was experienced with all systems of Telegraphy and Telephony on account of corrosive effect of the sand on the insulation of the cables.

The uncertainty of telegraphy made us fall back on visual signalling, both by Day and Night. In some cases the distances between visual Stations were great so the Heliograph was chiefly used during the daylight. In order to receive Heliographic messages from our advanced posts, I had to establish a visual Station on a sandhill a short distance South of our camp, and named the position Helio Hill.

One particularly bright and clear day—the 22nd of February, 1916—I was endeavouring to establish visual communication with the 34th Infantry Brigade on our right, who were supposed to be situated among the sandhills some five miles East of El Ferdan. As we only had a vague idea of their position it was necessary to sweep the horizon with the reflected light from the Helio mirror.

It was while occupied in this sweeping process that the incident to which I have referred, occurred.

Unintentionally I traversed the light a little too much towards the East—the direction in which we expected the enemy to be—when almost immediately, one of the Signallers drew my attention to a peculiar ray of light which seemed to come from a point due South-East of our position (Helio Hill). I noticed that this ray was vibrating in a vertical manner—that is, the beam appeared to rise and fall.

Although this ray was concentrated on some place to the South of our position it was possible to realize that the periodicity of the vibrations resembled the Morse Code.

In fact for quite a time we were able to recognize the letters R and U. These two letters sent together mean 'Who are you?' in Army code.

The first thought that flashed through my mind was that we had made a 'Faux pas,' and had given our position away to the Turks. However, after waiting awhile, the signals changed to W. H. D., which represented the 'call sign' of the Worcester Yeomanry.

It then occurred to me that possibly the ray we were reading was from a heliograph belonging to a cavalry patrol of this regiment. Consequently I aligned the Helio on the point on the horizon from which the ray seemed to emanate and gave one answering flash.

This was instantly answered by the ray being traversed on to our position, so that we received the full flash of the light.

To cut a long story short, it turned out that the signals were transmitted by the Worcester Yeomanry, and that they were patrolling in a North-easterly direction some 10 miles East of our position when they observed our unintentional flash, which they took to be a ' call up.'

By the time the column had halted and their signallers had set up the Helio, our position was not quite clear to them, so they guessed the direction, called R. U., and waited our reply. This accounted for the light being considerably to our right.

It appeared remarkable to me, at the time, that we should have been able to read Morse Code from a Heliograph ray, when the mirror disc was invisible.

The only way I can account for this phenomenon is that the light from the sun was very intense and the mirror of the Heliograph concentrated the reflected light into a narrow beam, thus making the ray so strong that it could be seen by an observer who was not in line with the beam."

The almost certain conclusion that the Pyramid's noon reflexions were visible.

If such a tiny ray of light as that reflected from the heliograph could be visible from a distance under the conditions observed, obviously the huge volume of the reflected beams projected from the Pyramid would be more clearly visible under the same conditions, or visible at least to the same extent under conditions considerably less favourable.

CHAPTER II.

THE EVIDENCES OF SCIENTIFIC ORIGINS IN ANCIENT EGYPT.

SECTION I.—GEOMETRICAL METROLOGY[1] AND DYNASTOLOGY.

¶ 77. THE SYSTEM OF MEASURES OF THE MEGALITHIC BUILDERS.

Work of Great Pyramid Builders the best expression of the science passed on to the British megalithic builders.

The evidence of archæology, folklore, and tradition—together with the astronomical alignments and datings—has established the Eastern origin of the builders of Stonehenge. This evidence has shown that the astronomical ideas of the British megalithic builders had been formulated in ancient Egypt. This formulation reached its highest phase of constructional expression in the work of the Great Pyramid builders.

British megalithic builders employed a system of measures in use in ancient Egypt.

The connection thus established as holding between early Britain and ancient Egypt leads at once to a further discovery. The megalithic builders who monumentalised in Britain the science of the ancient Egyptians employed in their constructions a system of measures in use in ancient Egypt. The route of the megalithic builders is the route of the ancient system of measures from the East into Britain.

The data confirming this have been supplied by the painstaking researches and comprehensive metrological classifications of Professor Petrie.

¶ 78. THE AREA OF STONEHENGE CIRCLE.

Stonehenge an expression of relationship of ancient Egyptian square and linear systems of measures.

From Petrie's data we find that the Stonehenge Circle is a constructional expression of the geometrical relations holding between the ancient Egyptian square and linear systems of measures. Its constructional diameter—shown on Plate I—is an important Egyptian unit of linear measures. The area defined by this diameter—*i.e.*, the circular area precisely internal to the outer ring of stones, is the exact area of an important Egyptian unit of square measure.

Stonehenge stone circle diameter and area are Egyptian units of measure.

[1]In this section, where metrological references are not stated, the researches and classifications of Prof. W. M. Flinders Petrie are to be understood. "Inductive Metrology:" "Weights and Measures" in Enc. Brit. (11th Ed.), vol. xxviii, pp. 482-484: and "Stonehenge."

The Egyptian Aroura and the ¼-Aroura.

Aroura Square side 100 common cubits long.

Common cubit 20.63 British inches.

¼-Aroura Circle diameter the diameter of Stonehenge stone circle.

The great unit of surface measure in ancient Egypt was the *aroura*. This was a square of length of side of an hundred common Egyptian cubits of 20.63 British inches each. This square was divided into four quarter squares; the quarter *aroura* being thus employed as a separate unit of square measure. The diameter of the circle of equal area to the area of the quarter *aroura* is 1163 British inches. A circle of this diameter falls precisely internal to the outer ring of stones forming the circle of Stonehenge. The diameter indicated by the present remaining stones of the circle, as determined by Petrie's survey, is 1168 British inches. Petrie argues that the measure of this diameter is derived from Egypt, where it occurs generally as 1162 or 1164 British inches.

¶ 79. THE SOLAR YEAR AND THE AROURA.

The Solar year relations of the Stonehenge ¼-Aroura.

The Solar year relations of the Egyptian ¼-Aroura.

Horapollo on the ¼-Aroura and the Egyptian year.

The Egyptian square year and circle year.

Thus at Stonehenge we find the Egyptian quarter *aroura* set out in circular structural form to define, by its alignments, the points and circuit of the solar year. A similar association held between the quarter *aroura* and the year in ancient Egypt. For as Horapollo states :—[1]

> "To represent the *current year*, they (the Egyptians) depict the fourth part of an *aroura :* now the *aroura* is a measure of land of an hundred cubits. And when they would express a year they say *a quarter*."

Hence in the Egyptian inscriptions there are two hieroglyphic representations of the year—one indicated by *a square*, and the other by *a circle*.

Herodotus on the Aroura square.

The Samian Cubit 20.62 British Inches. The Egyptian Cubit 20.63 British Inches.

Herodotus,[2] again, states that "the *aroura* is a square of a hundred cubits, the Egyptian cubit being the same as the Samian."

The cubit of Samos, as determined by Petrie, is 20.62 British inches, whereas the best average (Petrie's) for Egypt is 20.63 British inches.

¶ 80. THE ORIGIN OF THE AROURA.

The Solar Year 365.242 days.

The circumference of Circular ¼-Aroura 3652.42 units; its diameter 1162.6 units.

The statement of Horapollo—confirmed by the relations of the Stonehenge Circle—indicates that the *aroura* was derived from a representation of the year in measures. The original representation was in the form of a circle. The circumference of this circle measured 3652.42 selected units of length. This represented the circle of the solar year to a scale of 10 selected units of length to a day. The diameter then measured 1162.6 selected units of length.

Rectangle :— Circumference × Diameter. = Aroura. = 3652.42 × 1162.6.

Equal Square :— 2060.66 × 2060.66 = Aroura.

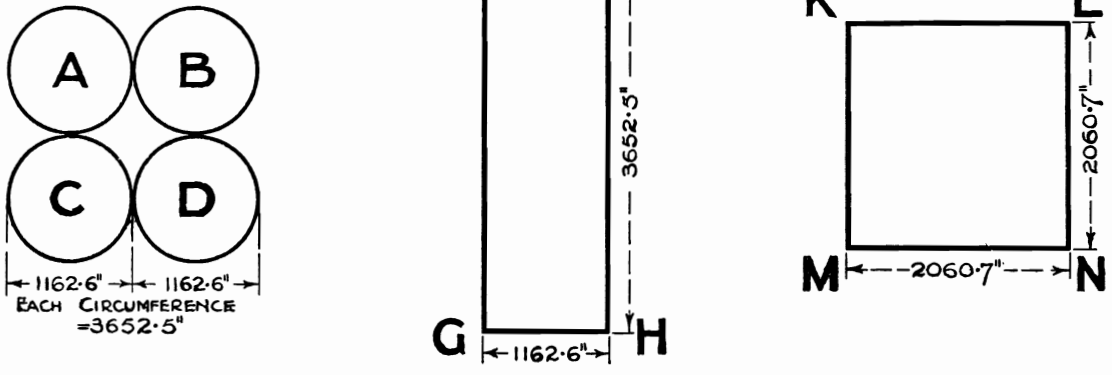
To reduce the circular area thus defined to a form suitable for land measuring, a rectangle was formed of length 3652.42 equal to the circumference of the circle, and of breadth 1162.6 equal to the diameter of the circle. The area of this rectangle was therefore equal to four times the area of the circle.[3] The rectangle thus produced was the intermediate stage of the *aroura*. Transformed into the form of a square of equal area, the *aroura* became a square of length of side 2060.66 selected units.

The sequence of derivation is shown on Plate XIII (refer Sect. III, Description of Plates, ¶ 135).

[1] Hieroglyphics, Bk. I, v.
[2] II, 168.
[3] Since area of circle $= \frac{\pi d^2}{4}$ and area of rectangle = circumference × diameter, $= \pi d \times d, = \pi d^2$.

PLATE XIII.

EQUAL AREAS



EACH COMMON CUBIT = 20·607"

100 CUBITS OF AREA LONG BY 1 CUBIT OF AREA WIDE

1/100TH STRIP OF THE EGYPTIAN AROURA

ARC LENGTH
12 CIRCUMFERENTIAL FEET

50 DIAMETRIC FEET

¶ 81. THE ORIGINAL LINEAR UNIT AND THE ORIGIN OF THE COMMON CUBIT.

Side of Square Aroura = 2060.66 units = 100 common Egyptian Cubits of 20.6066 units (Actually 20.63 British Inches)

1 primitive unit = 1.0011 British inches

The division of the *aroura* square side into 100 parts—as observed by Herodotus and Horapollo—supplied the common Egyptian cubit of 20.6066 units = 20.63 British inches. The most general value of the common Egyptian cubit observed by Petrie in the best work of the Pyramid builders is 20.629 British inches, from which the original selected unit = 1.0011 British inches, as stated to 4th decimal place, or $\frac{11}{10.000}$ths of an inch longer than the British inch.

The latter values agree closely with the mean Gregorian year value of 365.2425 days as basis, giving a basal circumference of 3652.425 selected units of length. These units we may now define as " Primitive inches," and hereafter refer to simply as P inches, or P″, avoiding confusion with British inches by stating the latter as B inches, or B″.

¶ 82. THE ANCIENT EGYPTIAN SYSTEM OF MEASURES.

Ancient Egyptian measures devised to avoid π relationship in calculations

Simple relations established between circles and segments of circles on one hand and straight line figures on the other hand.

With the preceding data as basis, it is found that the ancient Egyptians formulated a system of measures that, in the case of circular areas, and sectors of circles, avoided the repeatedly recurring trouble of the π relationship. By employing in their everyday work separate units and scales for circumferences, diameters, and areas, they avoided calculations that embodied the troublesome ratio of diameter to circumference. Simple formulæ were drawn up from which the circumferences and areas of circles, or sectors of circles, were immediately obtained from the diameter, or *vice versa*.

Sectors were correctly treated by analogy as triangles, by the following true relationship :—

Area of Sector .. .. = " Base " of Sector × half " height " of Sector.
= " Arc " of Sector × half radius.

The geometrical analogy leading to this relationship is explained for the particular case of quadrants in Plate XIV. The same treatment holds for similar sectors, *i.e.*, sectors whose arcs are subtended by the same angle.

Different Units of Measure :— Linear Digits, Feet and Cubits —for Diameters, Circumferences, and Straight Line Figures.

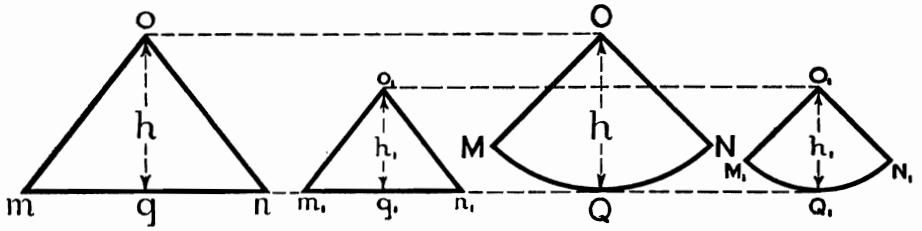
The principal units of measure formulated to effect the various translations were the following :—

The Linear Digit, Foot and Cubit of Diameter.
The Linear Digit, Foot and Cubit of Circumference.
The Linear Digit, Foot and Cubit of Square Measure.

¶ 83. THE SYSTEM OF LINEAR UNITS.

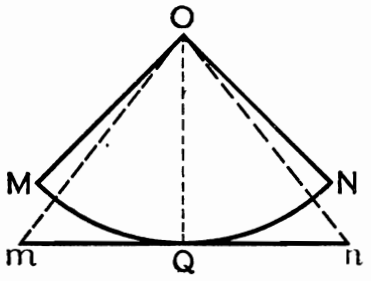
(The algebraic relationship of units is as stated in Section III, Description of Plates, ¶ 137a).

GEOMETRICAL ANALOGY

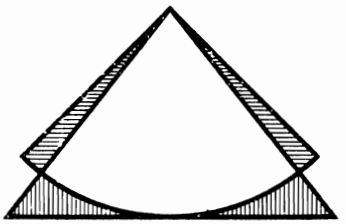


SIMILAR TRIANGLES

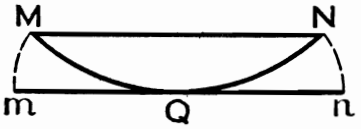
SIMILAR QUADRANTS



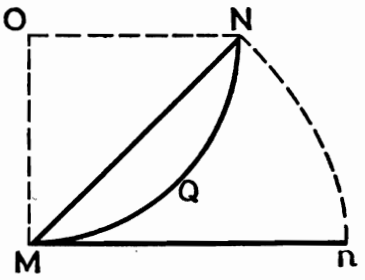
QUADRANT ARC DEVELOPED ON MID-TANGENT GIVES TRIANGLE OF EQUAL AREA



VERTICAL SHADED AREAS EQUAL HORIZONTAL SHADED AREAS



EGYPTIAN CONCEPTION OF QUADRANT ARC DEVELOPMENT MQN TO mQn



ORDINARY CONCEPTION OF QUADRANT ARC DEVELOPMENT MQN TO Mn

To obtain the Units of Diameter, the standard diameter of 1162.6 P. (=1163.88 B″) was divided into :—

The Units of Diameter.

(a) 64 diametric cubits of 18.1656 P″ each (18.1856 B″).
(b) 100 „ feet of 11.626 P″ „ (11.6388 B″).
(c) 1600 „ digits of 0.7266 P″ „ (0.7274 B″).

The Units of Circumference were obtained by dividing the standard circumference of 3652.425 P″ (=3656.44 B″) into :—

The Units of Circumference.

(a) 200 circumferential cubits of 18.2621 P″ (18.2822 B″).
(b) 300 „ feet of 12.1748 P″ (12.1881 B″).
(c) 5000 „ digits of 0.7305 P″ (0.7313 B″).

The Linear Units of Square measure were derived by dividing the side of the square of area equal to the area of the standard circle into :—

The Linear Units of Square Measure.

(a) 50 common cubits of 20.6066 P″ (20.629 B″).
(b) 1600 linear digits of 0.6440 P″ (0.6447 B″).

An illustration of the various units in operation is figured on Plate XIII. Here the $\frac{1}{100}$th strip of *aroura*, *i.e.*, a strip of 100 common cubits long by 1 common cubit wide,=area of sector, of arc length 12 circumferential feet, and diameter 50 diametric feet. Worked examples are given in Section III, ¶ ¶ 137, b and c.

¶ 84. THE SACRED HEBREW CUBIT.

The Division of the various Line Cubits into 25.

Comparative scales of the various units are figured on Plate XV. Reference to this shows that there are 25 Diametric Digits in the Diametric Cubit, and 25 Circumferential Digits in the Circumferential Cubit. These suggest that the Basal Cubit of the original Primitive inch system consisted of 25 P. inches. This gives the value of the Sacred Hebrew Cubit as derived by Sir Isaac Newton, and since confirmed by the metrological researches of Oppert, Petrie, and others. This again confirms the sequence as to Euphratean origins obtained in Chapter I.

The Basal Cubit the Sacred Hebrew Cubit.

The Sacred Hebrew Cubit in Egypt during period of Semitic Domination in Dynasty XVIII.

Completing this connection, Petrie finds the 25 inches' cubit in use in Egypt during the period of Dynasty XVIII. At this time the Egyptian language and the political and religious institutions of Egypt were strongly influenced by a powerful Semitic faction in Egypt.[1] Around the same time Stonehenge and similar monuments were being built in Britain by a race whose astronomical and metrological cults evidence Egyptian influence, yet whose folklore and traditions indicate Semitic origins.

Same period for Construction of stone circle at Stonehenge.

Hebrew Sacred Cubit not Egyptian, but Egyptian Units of measures derived from it.

The Sacred Cubit of 25 P. inches (Plate XV) never occurs in Egypt unless during periods of Semitic dominance. The other systems of Plate XV belong to the whole period of Egyptian history. The fact that these systems were derived from the scale of the Sacred Cubit of 25 P. inches again confirms that the Egyptian units of measure were not formulated in Egypt. The sacred system and its derived Egyptian Units all clearly belong to the period of the former civilization pictured in ¶ ¶ 41-47.

The Related systems formulated by the former Civilisation.

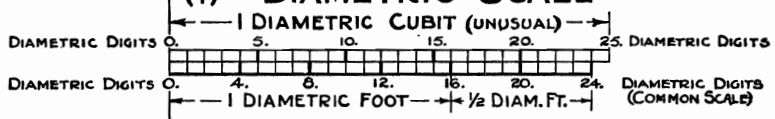
[1]Petrie, " Hist. Egypt," Vol. II, pp. 146-152.

COMPARISON OF ANCIENT SCALES OF MEASUREMENT (REDUCED)

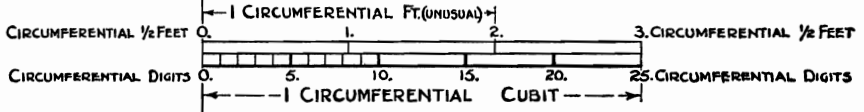
SACRED SCALE

CIVIL SCALES

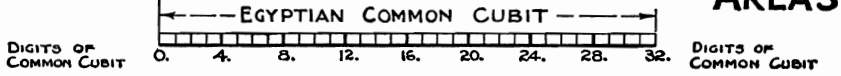
(1) DIAMETRIC SCALE



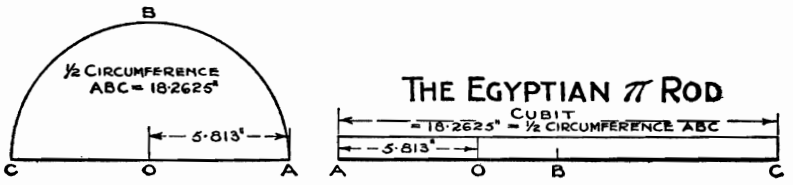
(2) CIRCUMFERENTIAL SCALE



(3) SCALE FOR SIDES OF RECTILINEAR AREAS



ANCIENT EGYPTIAN π RECORD



$$\frac{\text{CIRCUMFERENCE}}{\text{DIAMETER}} = \frac{36{\cdot}525}{11{\cdot}626} = 3{\cdot}14159 = \pi$$

$$\frac{\text{½ CIRCUMFERENCE}}{\text{RADIUS}} = \frac{ABC}{OA} = \frac{18{\cdot}2625}{5{\cdot}813} = 3{\cdot}14159 = \pi$$

¶ 85. THE FOOT OR SACRED HALF-CUBIT OF 12½ INCHES.

The Sacred Half-cubit. (12½ inches).

According to Petrie, the half-cubit (12½ inches) appears in Babylonia as the foot of the Babylonian system of measures. It appears also in ancient Greece (12.44 to 12.62 B″), in Etruria (12.45 B″ average), in what Petrie deems to be *Roman* Britain, and in medieval England (12.47 B″ average). The migratory sequence indicated clearly confirms the Euphratean connections established in Chapter I.

Its Track :— Babylonia, Greece, Etruria, Roman Britain, Medieval England.

Ancient Cornwall Acre, 40 perches × 4 perches, with perch =16 feet.

A statute of Richard I, belonging to the year 1199, defines an acre in Cornwall as " 40 perches in length and 4 in breadth and every perch of 16 feet in length."[1] Cornwall was the principal British centre of the Oriental colonists from 2000 B.C. onwards. Their influence still predominates in the folklore, traditions, and customs of Cornwall. It is obviously from this race, with its Mediterranean and Atlantic ports of call, that ancient Greece, Etruria and Britain derived the Sacred half-cubit of 12½ P. inches.

The Coming to Cornwall of the Sacred Half-Cubit.

Ancient Perch : 16 feet of 12½ inches =200 inches.

Modern Perch : 16½ feet of 12 inches =198 inches.

Now 16 feet of 12½ P. inches give the ancient perch in Cornwall as consisting of 200 P. inches. The modern perch or rod consists of 16½ feet of 12 inches, or 198 inches. The numerical interchange and the reason for it are obvious. The inch remained the basal unit, unchanged, except for small local variations. The perch also remained practically unchanged—losing but 1% of its original value.

¶ 86. THE RELATION BETWEEN ANCIENT AND MODERN BRITISH MEASURES.

Ancient Furlong : =40 perches =40 × 200 ins., =8,000 inches.

Ancient Mile : =8 furlongs =64,000 inches.

The manner of effecting the change from the ancient to the modern value of the perch or rod suggests that the numerical relations between the perch and the higher units were maintained. Now there are 40 perches or rods in the furlong, and 8 furlongs in the mile. With the ancient perch as 200 inches, this gives the primitive basal furlong as consisting of 8,000 inches, and the primitive basal mile of 64,000 inches.

Ancient Unit of 10 acres.

As a square its circuit= Half-a-mile, or 32,000 inches

An acre in Cornwall (in 1199 A.D. and earlier) was measured as 40 perches by 4 perches. This is the $\frac{1}{10}$th strip of a square of 10 acres area. The side of the square of 10 acres therefore measured 1 furlong, or 8,000 inches, and the circuit of the 10 acres square, 4 furlongs or the half-mile,—32,000 inches.

Ancient and Modern Relation :— 640 acres =1 sq. mile.

Following from these relations we find that

640 primitive acres = 1 sq. mile (primitive.)

This relation between the acre and the square mile still holds.

The decimal subdivision of areas into $\frac{1}{10}$th and $\frac{1}{100}$th strips of squares—indicated by the definition of the ancient acre in Cornwall—is both Egyptian and Semitic. It occurs in the case of the Egyptian *aroura*. The 10 acre square was a large unit of square measure of the Hebrews. (Isaiah v. 10.)

[1]10th Richard I, statute " Inter Fines " states " Acra in Cornwal continent 40 perticata in longitudine et 4 in latitudine et qua libet perticata de 16 pedibus in longitudine."

¶ 87. THE MEDIEVAL ENGLISH PROCESS OF COMPROMISE.

A decimal subdivision of the ancient Perch of 200 inches gave the ancient Ell or yard of 40 inches. Petrie gives the latter as averaging 39.66 B″. The foot of this system—the Belgic Foot—is $\frac{1}{3}$ of the ell or yard=$13\frac{1}{3}$″ (13.22 B″ Petrie). With this system Petrie finds a longer mile of 10 furlongs in use from as far back as the 13th century. This system is as follows :—

Ancient Yard : =40 inches =3 Belgic feet of 13⅓ inches.

The Ancient Long Mile of 10 furlongs.

Belgic Foot.	3=Yard.	2=Fathom.	10=Chain.	10=Furlong.	10=Mile.
$13\frac{1}{3}$″.	40″.	80″.	800″.	8,000″.	80,000″.

Its Decimal System.

Petrie's values extended from his average of the Belgic foot in England (13.22″) are :—

Foot.	Yard.	Fathom.	Chain.	Furlong.	Mile.
13.22.	39.66.	79.32.	793.	7,932.	79,320 B″.

It will be observed that the furlong (8,000″) is of the same value as was obtained in ¶ 86.

The reason for the difference evidenced by Petrie's examples is that these are all from buildings belonging to the 10th to 15th centuries, when the Belgic foot and the foot of $12\frac{1}{2}$ inches still competed with the legal foot of 12 inches instituted in the 10th century. The legal foot altered the perch or rod to 198″ in place of the former 200″, which contained 15 Belgic feet of $13\frac{1}{3}$ P inches. To effect a compromise between the two competing systems, the perch or rod of 198″ was reckoned as containing 15 Belgic feet. This gave an adjusted foot of 13.2 P″ (13.22 B″, as Petrie above).

Petrie's Examples of Belgic Foot derived from buildings of 10th-15th centuries.

Legal foot of 12 inches instituted in 10th century

Compromise effected between two systems :— Relation retained that 15 Belgic feet =1 perch.

Petrie, however, observes that the latter foot originated around Asia Minor, averaging there 13.35 B″, and passed to Greece as 13.36 B″. Now $13\frac{1}{3}$ Primitive inches of value 1.0011 British inches (¶ 81) equal 13.348 B. inches, or to 2nd place, 13.35 B. inches, as in Asia Minor.

1% reduction in perch made 1% reduction in Belgic foot.

¶ 88. THE EGYPTIAN METROLOGICAL EVIDENCE.

Returning to consideration of the Egyptian system of diametric and circumferential measures and their linear standards for areas, we find that all the values of ¶ 83 are found indicated in the structural measurements of the ancient Egyptians. A half diametric foot and the circumferential cubit were actually, in one case noted by Petrie, found on the same cubit rod. This is a graphical representation of the π relationship, as the half diametric foot (5.813 P″) was the radius of a circle of 36.525 P″ circumference, of which the circumferential cubit (18.2625 P″) was the half circumference. (Refer Plate XV, lower portion.)

Structural Measurements in Egypt give ancient diametric and circumferential units and linear units for areas.

An Egyptian π Rod.

Metrologists, having failed to observe the origin of the system of measures, have universally supposed the diametric digit (0.7274 B″), and the circumferential digit (0.7313 B″), and also the diametric cubit (18.1856 B″), and the

Metrologists confuse diametric digit and circumferential digit, and the respective cubits.

circumferential cubit (18.2822 B″), to be variable values of the same digit and the same cubit respectively. They therefore average the two values, in each case, obtaining the mean values as follows:—

The mistake in averaging two separate systems.

Diametric Cubit	..=18.1856 B″.
Circumferential Cubit	..=18.2822 B″.
Mean Cubit of Metrologists	..=18.2339 B″.

This is stated by Petrie as 18.23 B″. Again,

Diametric Digit	..=0.7274 B″.
Circumferential Digit	..=0.7313 B″.
Mean Digit of Metrologists	..=0.72935 B″.

This is stated by Petrie as averaging 0.729 B″. From Greek remains Petrie obtained 0.7296 B″.

Possibility that Egyptians themselves, at an early date, merged the two systems into one for ordinary use.

It is quite possible, however, that for ordinary everyday commercial use, the two separate systems were merged into a single "rule-of-thumb" system at a comparatively early date in the dynastic history of Egypt. After all, as we have seen, Egypt is only a stage in the tracing of origins to their source in a former civilisation. The Egyptians, at an early date, lost the meaning and application of much that they have handed on to later days for elucidation.

¶ 89. THE GREEK SYSTEM OF MEASURES DERIVED FROM EGYPT.

Petrie's values for the Greek Decimal System of Linear Measures.

With the average values of ¶ 88 as basis, Petrie has grouped the known data from buildings in Greece as follows:—

Old Digit	25=Cubit: 4= / 100 .. .. ..=	Orguia.	10=Amma.	10=Stadion.
B″ 0.729.	18.2.	72.9.	729.	7296.

But with the stadion=7,296 B″, as stated by Petrie above, the values are accurately:—

The Mean Values of Egyptian Diametric and Circumferential Measures.

Old Digit.	Cubit.	Orguia.	Amma.	Stadion.
B″ 0.7296.	18.24.	72.96.	729.6.	7296.

Thus indicating that the system tabulated is the mean of the two early Egyptian systems—diametric and circumferential.

Petrie further shows that the cubit of 18.24 B″, was also divided by the Greeks into 24 digits, obtaining the new Greek digit as 0.76 B″.

He shows again that the Greek foot was taken as $\frac{2}{3}$ of the mean cubit of 18.24 B″, and therefore as 12.16 B″. This is closely approximate to the Egyptian diametric foot of 12.1748 P″=12.188 B″. (¶ 83.)

Evidence as to Greek Measures primarily derived from separate Egyptian Systems.. Circumferential and Diametric.

The resulting Greek system, as stated by Petrie, is as follows :—

	Foot.	10=Acaena.	10=Plethron.
B″.	12.16.	121.6.	1216.

The early Greeks also used the diametric foot of 11.626 inches. (¶ 83.)

¶ 90. THE ROMAN SYSTEM OF MEASURES.

The Roman system of measures was derived—through the Greeks—from the Egyptian diametric system. Its basis was the diametric digit of 0.7266 inches, and the diametric foot of 11.626 inches (¶ 83). As an average from existing Roman remains, Petrie gives the system as follows :—

Roman System primarily derived from Egyptian Diametric System.

Digitus.	4=Palmus.	4=Pes.	5=Passus.	125=Stadium.	8=Milliare.
B″ 0.726.	2.90.	11.62.	58.1.	7,262.	58,100.

The above system was used by the Romans in Britain and Africa.

The Roman foot appears in Medieval England as 11.6 B″.

¶ 91. ANCIENT RECORDS OF AN EGYPTIAN PYRAMID OF MEASURES.

The data from ancient Egyptian documentary sources show that the various metrological dimensions and standards of linear and square measure were preserved in the form of an existing Pyramid. The primary unit of measurement, the various outstanding dimensions and structural peculiarities, and the angles of the face slope and the Apex angle of this existing Pyramid are all precisely defined by the Egyptian literary data.

Ancient Literary Records of a Metrological Monument.

Its form Pyramidal.

The data define as follows :—

(1) *GENERAL BASIS OF PYRAMID'S DESIGN.*

Its unit the Inch.

(a) That the unit of dimensions .. .. = 1 P. inch.
= 1.0011 Brit. inch.

Base Circuit 36,525.

Height 5,813

(b) That the angle of face slope with horizontal = 51°–51′–14″.3.

Face slope 51°–51′–14″.3.

(c) That the apex angle .. .. = 76°–17′–31″.4.

Apex angle 76°–17′–31″.4.

(d) That the base square circuit .. .. = 36,524 or 5 P. inches.
and (defined independently) .. .. = 1,772 common Egyptian cubits (of 20.63 B. inches).

(e) That the height from base to apex.. .. = 5,813 P. inches.

The data define (b) and (c) independently of (d) and (e).

(ii) *DETAILS OF DESIGN.*

A Square Circuit 25,827 at level 1,702½.

(a) That the Pyramid indicated a square circuit of 25,826 or 7 P. inches (the sum of the diagonals of the base square) at a height of 1702½ P. inches above the base, both dimensions being given independently of the other.

A Square Circuit 29,220 at Level 1,162.6

(b) That the Pyramid indicated a square circuit of 29,220 P. inches at a height of 1162.6 P. inches above the base.

The latter defining "Aroura" Rectangle 3652.5 × 1162.6

(c) That the latter defined, in elevation, the *aroura* rectangle of 3652.5 P. inches × 1162.6 P. inches, and a series of such rectangles (eight in all) encircling the Pyramid as seen in its four elevations of circuit.

Pyramid Vertical Section Area = Square of Side 5151.6.

(d) That the Pyramid vertical section was equal in area to a square of length of side = 5151.6 P. inches; this being defined independently of the other relations.

The quarter-*aroura* goes into the latter square, or the area of the Pyramid section, 25 times.

¶ 92. THE FICTITIOUS PYRAMID DYNASTOLOGY OF THE EGYPTIANS.

Conception of Ancient Egyptians that the Standard Pyramid Measures denoted duration of Astronomical Periods.

The Pyramid measures thus standardised were all associated with the geometry of the year. For this reason, and for other reasons to be explained later, the Egyptians of various periods, subsequent to the erection of the monument, deemed that all its measurements denoted the duration in years of astronomical periods. In accordance with this conception, they formulated various systems of fictitious or mythological chronology. Each cult had its particular system, always, however, based numerically on the Pyramid year cycle geometry. Each system claimed to be a presentation of the chronology of the Egyptian Dynasties—Divine and human. The systems all differed considerably, so that it is impossible to synchronize the various intervals given for the same Dynastic periods.

On this conception Egyptians framed their Mythical Systems of Dynastic Chronology.

Various Versions of such Dynastic Systems edited by Egyptian Priest Manetho in 3rd Century B.C.

All the systems in existence in the third century B.C., were edited by the Egyptian priest, Manetho, and entered in his work on Egyptian History, "Ægyptiaci," written in Greek. Several versions of the systems of fictitious chronology, known as the Egyptian "King Lists," were extracted from Manetho's work by Julius Africanus in the third century A.D. The composite nature of the King Lists as given by Africanus is seen by analysis of the various alternative details of summations of years.

Manetho's King Lists preserved by Julius Africanus and Eusebius in 3rd Century A.D

Another version was preserved by Eusebius—also in the third century A.D.—together with the version known as the Armenian Version of Eusebius. The versions of Africanus and Eusebius were, in turn, preserved by George Syncellus about 800 A.D. With the exception of certain important extracts from Manetho's history, preserved by Josephus in his *Contra Apion.*, this is all that now remains of Manetho's notable work.

To account for the difference between the chief version of Africanus and the version of Eusebius, Syncellus accused Eusebius of tampering with the figures as given by Manetho. The analysis given in this chapter, however, shows that the version preserved by Eusebius, as stated to the reign of Amasis II, was in existence in the fifth century B.C.—700 years before Africanus was born, and 200 years before Manetho.

Version of Eusebius as old as 5th Century B.C.

Other associated numerical details are found in records of the period of Dynasties XVIII and XIX.

A typical tabulation and analysis of the King Lists of Manetho—and the different versions of these and other lists—are shown on Plate XVI. Had this matter been dealt with otherwise than by the comprehensive tabulation and analysis given, the subject-matter would have extended to many tedious pages of text, without giving a fraction of the elucidation resulting from the graphical presentation of Plate XVI. For the statement of Manetho's, and other King Lists, and for the historical evolution of the various dynastic schemes of Plate XVI, the reader is referred to the Appendix.

Graphical Presentation of the Associated Data.

Plate XVI

Its Elucidating Features.

¶ 93. EGYPTIAN KING LISTS DEFINE THE STANDARD PYRAMID.

Reference to Plate XVI shows that the numerical details of the King Lists define the standard Pyramid as follows :—

Dynastological Dimensions of Standard Pyramid.

(a) *THE HEIGHT OF THE STANDARD PYRAMID.*

Height :— Dynasty of Manes= 5,813 years.

Table A. Dynasty of Manes = 5,813.
= Radius of Circle, 36,524 or 5.
Hephaistos to Osiris *and* Isis = 2 × 5,813 = 11,626.
= Diameter of Circle, 36,524 or 5.

(b) *THE BASE CIRCUIT OF THE STANDARD PYRAMID.*

Base Circuit : Total gods and kings= 36,525 years.

Table E. Old Chronicle. Gods and Kings = 36,525.
Table F. Gods and Kings to 139 A.D. .. = 36,524.

(c) *THE BASE SQUARE OF THE STANDARD PYRAMID.*

Base Sides and Diagonals.

The diagonal is defined by the two sides, each 9,131¼, and totalling 18,262½. The resulting diagonal is 12,913½. This relationship is given as follows :—

2 Sides 18,262
Diagonal 12,913

(Fig. B). Base Diagonal .. .. .. = 12,913½ (obviously period Gods).
Version Africanus. Table C (4) .. .. = 5,349 Human Kings.

Difference 5,349

2 Sides defining Diagonal .. .. .. = 18,262½ Gods and Kings.

Years of Kings.

¼-Base :— Kings= 4565 years.

The half-side of the base square is defined by Table C (7), Version Eusebius, Kings = 4,565. (Fig. B.)

(d) *THE ANGLE OF SLOPE OF THE STANDARD PYRAMID.*

Face Slope 51°–51′–14″.3.

The Pyramid half base side and the Pyramid height define the Pyramid angle of slope as 51°–51′–14″.3. This however, is independently defined by Table C (10), Version Castor, Kings = 3,720 (Fig. A), the arc of the circle of 25,826 or 7 corresponding to the angle 51°–51′–14″.3.

Equivalent Arc of 25,827 Circle= 3,720. Years of Kings.

Apex Angle :— Arc of Circle = 5,473½ Years of Kings.

Again, the apex angle is defined as the corresponding arc of the circle of 25,827, thus Table C (2), Kings = 5,474 for 5,473½ exact. (Fig. A.)

Definition of Angles proves Pyramid Intention.

These relations prove that relations (a) to (c) apply to the Standard Pyramid, and not alone to the year circle of 36,524 or 5 circumference.

(e) *THE SQUARE CIRCUIT OF* 25,826 *or* 7.

Divine Dynasties= 25,826 years.

This is equal to the summation of the Base Diagonals (Fig. B). The circuit occurs at level MN of Fig. A., where height of MN above base = KC = 1,702½. This is defined in Table A as Dynasty III of Demi-gods (Memphis) = 1,702.

Sum of Base Diagonals and Square Circuit at level 1702½ Dynasty III Demi-gods.

$MN = \frac{25,826 \text{ or } 7}{4}$. So that square circuit round Pyramid at MN = 25,826 or 7 = Divine Dynasties (Table A).

(f) *SQUARE OF AREA EQUAL TO STANDARD PYRAMID SECTION.*

The side of this square is 5,151½. This is defined as follows :—

Side of Square of equal area 5151½.

Version Africanus, 1st 26 Dynasties = 5,151½
Last 5 Dynasties = 197⅔

Years of Kings 1st 26 Dynasties.

Table C (4). 31 Human Dynasties = 5,349⅙

This connects with item (c) above, 5,349 being common to both, and identifying 5,151½ with the same geometry as includes the half base circuit, 18,262½ and the base diagonal, 12,913½.

¶ 94. EGYPTIAN KING LISTS DEFINE THE STANDARD UNIT.

1st 15 Kings Old Chronicle 443 years.

The Old Chronicle of Egypt (Plate XVI, Table E) gives, for the first 15 generations of the Cynic (Sothic) Cycle, the duration of 443 years. This is the initial item of the human dynasties in this List.

Base Side 9,131¼ inches = 443 Common Cubits

Now the base side AB (Plate XVI, Figs. A and B) of the Standard Pyramid consists of 9,131¼ units, and a measure of 9,131¼ Primitive inches (each 1.0011 B. inches) consists of 443.1 Common Egyptian Cubits of 20.6066 P. inches (20.63 British inches). The occurrence of the number 443 in the Old Chronicle therefore proves that the base side of the Standard Pyramid consisted of 443 common cubits, and that this measure equalled $\frac{36,524 \text{ or } 5}{4}$ standard units. As the common cubit is known (20.63 B″), the identity gives the standard unit as the Primitive inch of the value of 1.0011 British inch.

This defines Unit of Standard Pyramid as 1 inch = 1.0011 British Inch.

It should, perhaps, be explained that 443, whilst defining the standard Pyramid base in common cubits, is also half the numerical value of the length of side of a square of area equal to a quadrant of radius 1,000 units of any value. Hence its importance as an independent number, accurately calculated as 443.1134627, regardless of the value of unit. It is the latter value that defines the Primitive inch as 1.0011 B. inches, from the identity 36,524 P. inches = 4 × 443.1134627 cubits of 20.63 British inches.

That the number 443 was known to be connected with the Standard Pyramid, and that the latter was identified with the Great Pyramid is proved by the following :—

1st 15 Kings of Eratosthenes 443 years, to end of reign of Builder of Great Pyramid.

(a) That the King List of Eratosthenes gives the duration of the first 15 Dynastic kings of Egypt as 443 years—this proving that the 15 generations of the Old Chronicle for 443 years are the first 15 Dynastic Kings.

This associates the Standard Pyramid of lists with the Great Pyramid.

(b) That the 15th Dynastic king of the list of Eratosthenes is Saophis I, with whose reign inclusive the 443 years end.

(c) That the Saophis I of Eratosthenes is the Suphis I of Manetho, the IVth Dynasty king Khufu—the Cheops of Herodotus—who built the Great Pyramid.

¶ 95. THE ORIGINAL OLD CHRONICLE OF EGYPT.

The occurrence of 443 as the number of years for the first 15 dynastic kings of Egypt, and the fact that 443 is the number of common cubits in the Standard Pyramid's base side suggest a further identification. This is that the Divine Dynasties and the first 15 human kings were given the duration of 4×443 years, this being derived from the Standard Pyramid's base circuit of 1,772 common cubits=36,524 or 5 primitive inches. The latter identity thus obviously suggested the later extension to the duration of Gods and Kings for 36,525 years, as given in the Old Chronicle.

Square Circuit of 36,525 P. Inches = 1772 Common Cubits.

If the suggestion above is correct the detailed statement of the system suggested should confirm itself. Thus, as suggested,

Originally, Gods and Demi-gods	$= 3 \times 443 = 1{,}329$
First 15 human kings	$= 443$
	1,772
Remaining human kings, as Old Chronicle	$= 1{,}881$
Definition of Length of *Aroura* Rectangle $3{,}652\frac{1}{2}$ (Plate XVI, Fig. C)	$3{,}653$

Original Old Chronicle

Gods 1772
Kings 1881
3653

Defines "Aroura" Rectangle $3652\frac{1}{2} \times 1162.6$.

Now the height of the *aroura* rectangle is 1162.6 and the Standard Pyramid section as represented in Plate XVI, Fig. C, contains two *aroura* rectangles. Confirming the relationship inferred,

The Old Chronicle, 1st 15 human kings	$= 443$
remaining do.	$= 1{,}881$
	$2 \times 1{,}162 = 2{,}324$

Old Chronicle Human Kings 2×1162 years.

Defines Two "Aroura" Rectangles.

defining the height of the two *aroura* rectangles—deleting the decimal of an inch.

¶ 96. THE MYSTERY OF MANETHO'S 113 GENERATIONS.

Now the generations of Gods and kings in the Old Chronicle are totalled as follows :—

(a) { 15 Gods
{ 8 Demi-gods

(b) { 15 generations of Cynic Cycle
{ 8 kings of Dynasty XVI

} (a) and (b) obviously a duplication.

(c) 67 kings, Dynasties XVII to XXX inclusive.

Total 113 gods and kings.

Old Chronicle added 113 descents for Gods and Kings stated as for 30 Dynasties only.

Syncellus, in introducing the List, however, states that the 30 dynasties contained 113 descents.

This, again, is explained by another statement from Syncellus concerning Manetho's Dynasties. This is as follows :—

Manetho's Human Kings of 30 Dynasties stated as 113 generations for 3555 years.

"The period of the 113 generations described by Manetho in his three volumes, comprises a sum total of 3,555 years."

Connection with Original Old Chronicle Period of 3652 years.

The latter total is one cycle of 97 years (¶ 33, ii (c),) short of 3,652 years, the basal total of the original Old Chronicle. It is also derived as follows:—

Circuit of square equal in area to circle of 29,220 circumference (Plate XVI, Table A, and Fig. C)	= 32,970
Manetho's 113 generations	= 3,555
Total of later Old Chronicle	= 36,525

The 3555 of Syncellus connects 29,220 of Manetho and 36,525 of later Old Chronicle.

Evidence of expansion of later systems.

These details and identities all assist in confirming that the later systems of the Lists were expanded from an original form—similar to that inferred for the original Old Chronicle—in which the basal total was 3,652 or 3 years.

Hence human period of Old Chronicle	= 2,324 years.
add 2 Nominal Solar Cycles	= 3,044 years.
Version Africanus, Plate XVI, Table C (5) ..	= 5,368 Years. Kings.

¶ 97. THE VERSION OF CASTOR.

In one version of Castor we have the following:—

Gods and demi-gods to Anubis, inclusive	= 1,333 years.
Remaining demi-gods	= 217
Human kings	= 2,100
Total = 3,652½ vague years =	3,650 Sothic years.

Version of Castor confirms original system of Old Chronicle of Egypt.

The statement confirms the general arrangement of the inferred original Old Chronicle. In detail it is confirmed by the 217 years of Castor appearing as the duration of the eight demi-gods in the Old Chronicle, and by the initial period of Castor—1,333 years—agreeing within four years with the inferred initial 1,329 years of the original Old Chronicle.

The original Old Chronicle, therefore, defined the inscribed *aroura* rectangle, 3652.5 × 1162.6 (Plate XVI, Fig. C), and the square base circuit (1,772 common cubits) of the Standard Pyramid.

¶ 98. THE SQUARE CIRCUIT OF 29,220.

Gods and Kings to Amasis II 29,220 years, circuit of standard Pyramid at 1162.6 level defining "Aroura" rectangles.

At the upper level of the *aroura* rectangles in the Standard Pyramid section (Plate XVI, Fig. C)—i.e., at level 1162.6—the square circuit is 29,220. This is the total number of years for gods and kings to the first year of Amasis II (Plate XVI, Table A). Comparison of the data narrated to Herodotus by the Egyptian priests in the 5th century B.C., with the statement of the Lists according to the version of Eusebius establishes this identity. It also establishes two important conclusions. These are,

Version of Eusebius in use in 5th Century B.C.

(a) That the version preserved by Eusebius was the version in use in the 5th Century B.C.

Theory of Sothic Cycle ending in 570 B.C.

(b) That a Sothic cycle was supposed to have ended in the 1st year of Amasis II (570 B.C.).

Now this clashes with the later theory that a Sothic cycle of 1,460 Sothic years ended in 139 A.D., which theory is the fundamental basis of the various modern Egyptological chronologies. Why the Egyptians of the 5th century B.C. adopted a theory equally erroneous is a matter that will be dealt with later. The fact of immediate importance is that they knew nothing concerning a Sothic cycle that was due to end in 139 A.D.

Egyptians of 5th Century B.C. knew nothing concerning the fundamental theory of modern Egyptological Chronology.

¶ 99. THE 35th COURSE OF THE GREAT PYRAMID.

The level of the Standard Pyramid circuit 29,220 (Plate XVI, Fig. C) is again defined as follows :—

Version Africanus, Human Kings = 4,651. Table B (8), Plate XVI.
Version Suidas, Gods and Kings = 4,650. Table B (9), Plate XVI.

1162.6 level of "Aroura" rectangles below apex= 4650.4 years of Dynasties.

The level of the circuit 29,220—1162.6 above the base—being 4650.4 below the Apex of the Standard Pyramid.

Now 1162.6 Primitive inches is the precise level of the axis of the 35th course of masonry in the Great Pyramid. This course is 50 P. inches deep, 25 inches (the Sacred Cubit) above and below the axis of the course at 1162.6 P″. As seen from a distance this 35th course is the most outstanding course in the Pyramid. It occurs after a series of courses generally 26 inches deep. With the exception of the two lowest courses, it is the deepest course in the Pyramid. This sudden increase in depth can only have been for the intention of pointing to the fact that the 35th course axis defines the *aroura*, and the height of 1162.6 P. inches. This intention is confirmed when we study the accurate Great Pyramid survey data of Professor Petrie in relation to the fact concerning the hollowing-in feature observed by him and discussed in our ¶¶ 18–20. The angle of slope of the Standard Pyramid derived in ¶ 93 (d) is also the angle of slope of the Great Pyramid, 51°–51′–14″.3.

This the axis level of prominently defined 35th course of Great Pyramid.

Same course defines sacred cubit of 25 P. inches.

¶ 100. THE DYNASTOLOGICAL STANDARD PYRAMID THE GREAT PYRAMID.

The square circuit of the Standard Pyramid base, by data of ¶ 94, is 36,524 P. inches. With 1 P. inch=1.0011 British inch, as derived in ¶ 81, and independently in ¶ 94, this circuit equals 36,564 British inches. The side of the square base of the Standard Pyramid was, therefore, 9,141 British inches. With the same hollowing-in feature as the Great Pyramid—which is hollowed in to a maximum extent of about 36 inches at the centre of each face slope—the dimension of 9,141 British inches between the centre of one base side and the centre of the opposite base side of the Standard Pyramid would be reduced by 2×36 inches, or 72 inches. The distance between centres of face slopes at the base of the Standard Pyramid would be 9,069 British inches (9,059 P. inches).

Standard Pyramid's base circuit 36,524 P. inches =36,564 Brit. inches.

Side of base 9141 Brit. inches.

With hollowing in as in Great Pyramid, distance between centres of opposite base sides is 72 ins. less than 9141 Brit. inches, = 9069 B″,= 9059 P″.

Existing surveyed distance between centres of opposite base sides of Great Pyramid= 9069 B″=9059 P″.

Four values obtained by Petrie for the corresponding dimension in the Great Pyramid are as follows :—

9069.4 B. inches	Petrie's stated range of possible error being ± 0.6 B. inch for each side.
9067.7 „ „	
9069.5 „ „	
9068.6 „ „	

Average value= 9068.8 B. inches ± 0.6 B. inches.

Great Pyramid Angle of Slope 51°-51′-14″.3 as in Standard Pyramid.

The Dynastological Standard Pyramid is the Great Pyramid

The value for the Great Pyramid, then, is identical with the value for the Standard Pyramid of the Dynastological Lists. Now the angle of slope of the Great Pyramid is 51°-51′-14″.3, as defined by the existing casing slope. This is identical with the angle of slope derived in ¶ 93 for the Standard Pyramid. The Standard Pyramid of the Dynastological Lists is, therefore, the Great Pyramid of Gizeh.

¶ 101. THE DIMENSIONS OF THE GREAT PYRAMID.

Great Pyramid base circuit = 36,524 P′, sum of base diagonals =25,826½ P′, its height 5813 P. inches.

Its 35th course axis defines the rectangular "Aroura" and the circuit of 29,220 P. inches.

The base circuit of the Great Pyramid then, is 36,524 primitive (or Pyramid) inches. Its base diagonals add 25826.5 Pyr. inches. Its height is 5,813 Pyr. inches, the radius of the circle of 36,524 Pyr. inches circumference. The axis of its 35th course defines the rectangular *aroura*, and its circuit the measure of 29219.4 Pyramid inches, expressed as 29,220 in the Dynastological Lists.

The reader will find this matter all clearly explained and diagrammatically illustrated on Plate XVII, where Petrie's surveyed measurements have been reduced to Pyramid inches.

General appearance of 35th course.

The general appearance of the 35th course is diagrammatically represented by the suddenly thicker course shown on Figs. a, b, and c of Plate XVII.

Diagram of core hollowing feature.

The hollowing in of the core masonry escarpments, prior to the placing of the casing stones, is illustrated in diagrammatic perspective on Plate XVIII.

The reader will find a more detailed and precise discussion in Chapter III. In this it will be shown that the extent of hollowing-in is geometrically connected with the displacement of the plane of the Great Pyramid's Passage System, and that the amount of this displacement (286.1 P″) is a well defined geometrical dimension of the Great Pyramid.

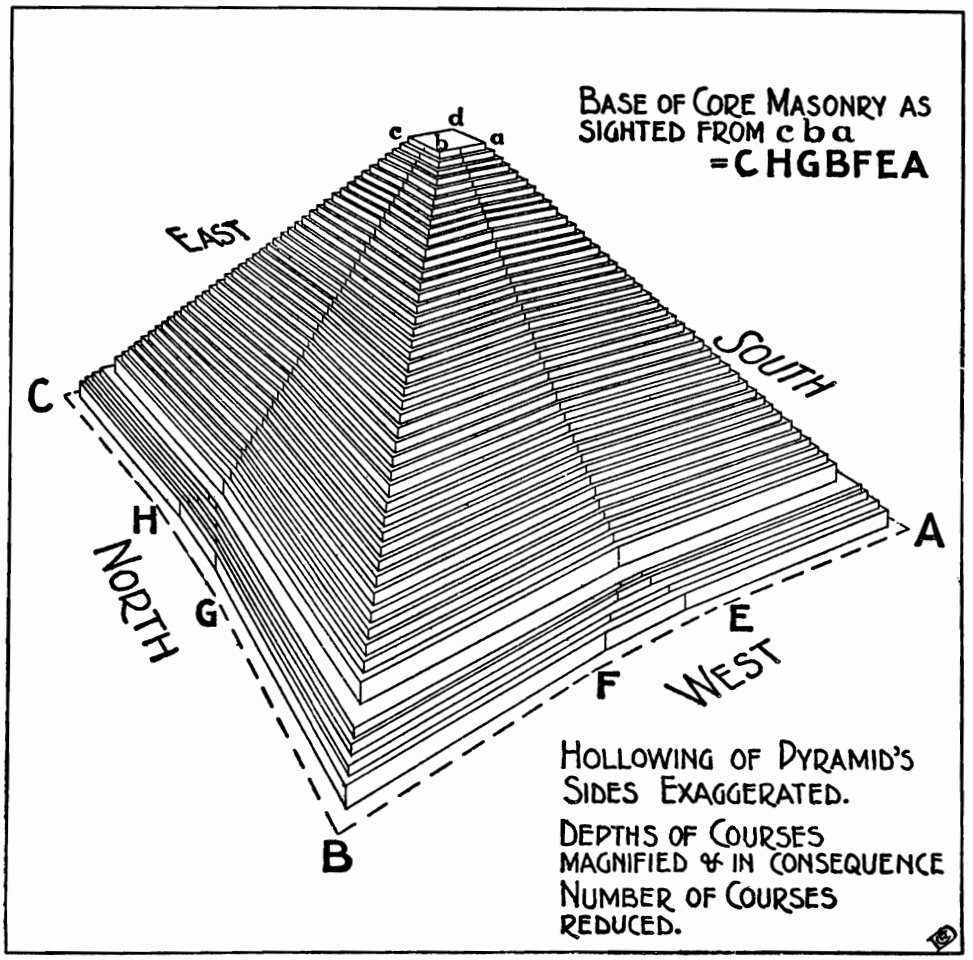
500 million Pyramid inches in Earth's polar dismeter.

Accident or intention?

As stated on Plate XVII, the resulting value of the Pyramid inch (accurately derived from ¶¶ 81 and 94) divides precisely 500,000,000 times into the Polar Diameter of the Earth, according to the latest determination of the latter by the U.S.A. surveys of 1906 and 1909. It is a matter for further discussion to show whether the coincidence is due to accident or design. This will be considered further in Chapter III.

PLATE XVIII.

DIAGRAMMATIC PERSPECTIVE VIEW ILLUSTRATING FEATURES OF GREAT PYRAMID'S CORE MASONRY.



¶ 102. A PRECESSIONAL CONSTANT?

Great Pyramid Measure of 25,826½ P' reckoned in Dynastological lists as indicating period of Precession of Equinoxes.

Its accurate estimate of precession

Connected with this question of intention is an important question relating to the significance the ancient Egyptians attached to the measurement of 25,826 or 7 Pyramid inches. (Plate XVI, Figs. A and B.) Up to the time of the Persian Conquest, they recognised 25,826 or 7 years to be the duration of the great astronomical cycle known as the period of the Precession of the Equinoxes. As a statement of the period of Precession it is as accurate as any modern determination. Whether, however, it is the precise interval or not does not immediately concern us. The matter of importance is that it

It is a simple function of the year value.

is a simple mathematical function of the numerical value of the Solar Year. As such it is a useful constant to which to refer variations in the annual rate of Precession, or variations in the mean rate of Precession over a number of years. Whether it was formerly employed in this manner, and for the purpose stated, will be settled by the evidence discussed later.

The period suitable as a constant of precession.

Was it used as such?

The period in years $=50\sqrt{2}$ times the Solar year in days $=25826.54$. Now $78\frac{1}{2}$ Phœnix cycles of 329 years (¶¶ 33, 37, and 38) $=25{,}826\frac{1}{2}$ years of the Phœnix cycle or 25,826.54 mean solar years. In this identity the half year of the Phœnix cycle must terminate, in accordance with the Calendar rulings, at Day 1, Month VII of the Calendar Cycle of 103 years. This fixes that the period of $25{,}826\frac{1}{2}$ years was recognised as a cycle.

$78\frac{1}{2}$ Phœnix cycles equal Pyramid's Precessional Constant.

As shown on Plate XVI, Table D, the division of the Period into 24—the Babylonian divisions of the ecliptic—indicates that the cycle was identified with the twelve divisions or signs of the Zodiac. The 1,076 years of Eratosthenes would, therefore, represent precession through a half Zodiacal Sign, at the rate of 25,826 years for the 12 signs. One summation of the totals of the Version of Africanus—a summation not shown on Plate XVI—gives 4,305 or 6 years to the beginning of Dynasty XIX. This represents precession through two Zodiacal signs. It seems clear enough from these identifications that the earlier Egyptians, at least, recognised the period of $25{,}826\frac{1}{2}$ years to be the Period of the Precession of the Equinoxes round the Zodiacal signs.

Duodecimal division of 25,826 period in Dynastological List proves intentional association with Precession of Equinoxes.

¶ 103. THE EARLY KNOWLEDGE CONCERNING PRECESSION.

48th century to 4th Century B.C., actual precession through 60° (2 Zodiacal signs) occupied 4380 years.

Now, although the interval of $25{,}826\frac{1}{2}$ years is the period—or almost exactly the period—of the Precession of the Equinoxes, the annual rate varies considerably. For this reason, the mean rate between the 48th century and the 4th century B.C., moved the Equinox round 60° of the ecliptic or through two Zodiacal signs in 4,380 years. Now 4,380 Sothic years equal 4,383 vague years.

Hence 4383 years of Human Kings to Amasis II.

The latter is the stated interval at the time of the 5th to 3rd centuries B.C. for the duration of human kings to the 1st year of Amasis II, 570 B.C. (Plate XVI, Table A, and ¶ 98.) It seems clear enough that a coincidence of this nature could only have originated from a knowledge of the obvious basis of the identity, or from a tradition concerning such knowledge. The knowledge concerning, and the reason for effecting the identity appear to have governed the framing of the List around the year 570 B.C. It is equally certain that this knowledge was lost before the 3rd century B.C., although the identity remained. At least the knowledge was never imparted to the Greeks.

Identity presupposes knowledge, or tradition based on previous knowledge concerning actual rate of precession.

Knowledge lost before 3rd century B.C.

¶ 104. SYNCELLUS AND THE OLD CHRONICLE ON THE PRECESSION OF THE EQUINOXES.

Later systems of Dynastological lists substitute 36,525 years for 25,826 years as period of precession.

The latter facts are clear from the nature of the list of Africanus, as developed in Plate XVI, Tables A and F, and from the later form of the Old Chronicle of Egypt (Plate XVI, Table E). These both indicate that the cycle of 25,826 years had been confused with a supposed precessional cycle of 36,525

years. This, indeed, is stated by Syncellus, in relating concerning the 36,525 years' summation of the Old Chronicle. Syncellus states that the period of 36,525 years " relates to the fabled periodical revolution of the Zodiac among the Egyptians and Greeks, that is, its revolution from a particular point to the same again, which point is the first minute of the first degree of that equinoctial sign which they call the Ram, as it is explained in the Genesis of Hermes and in the Cyrannian books."

The Statement of Syncellus concerning the late traditional cycle of precession, 36,525 years.

The sign here taken as datum belongs to later Egyptian times, when the Equinox fell in the Ram (Aries). In earlier times, the sign was Taurus, in which actual sign the Equinox fell from 4,700 B.C. to 1,800 B.C.—since the extent of the sign, as defined by its stars is about 40°. The actual extent of Aries (the Ram) is about 20°—as defined by its stars. The Equinox therefore fell in the Ram between 1,800 B.C. and 320 B.C.[1] About 320 B.C., the 1st point of Aries, defined by Syncellus above, therefore marked the diurnal commencement of the Vernal Equinoctial Year. This gives the epoch of the death of Alexander the Great (323 B.C.), and accounts for the origin of the theory that ended the alleged precessional period of 36,525 years about this time.

Why this alleged precessional period was represented as ending at the Zodiacal 1st point of Aries around the date of Alexander's conquest of Egypt.

¶ 105. HOW THE DURATION OF 36,525 YEARS WAS IDENTIFIED AS PERIOD OF PRECESSION.

It is clear that the confusion arose first from the period of 4,380 years. Originally this was identified correctly as the number of years taken by the Equinox, between 4,700 B.C. and 320 B.C. to travel backwards through 60° of the ecliptic, from 1st point of Gemini, through Taurus and Aries, to 1st point of Aries. The termination of this period was then prematurely attached to 570 B.C., the 1st year of Amasis II, and identified as three Sothic cycles of 1,461 vague years,=4,383 vague years,=4,380 Sothic years. 25 of these Sothic cycles=36,525 vague years; whereas the Sothic cycle fails to divide into the Precessional period of 25,826½ years. The latter, however, contains 78½ Phœnix cycles of 329 years. The Phœnix cycle in the Hebrew Chronology is associated with a period of 1,461 solar years (¶ 39), and from this originated the erroneous identification—noted by Tacitus (¶ 39)—that the Phœnix cycle was a period of 1,461 years. This sequence of error was obviously the origin of the late conception that the period of Precession was 36,525 years.

Precession from 1st point of Gemini at 4,700 B.C. to 1st point of Aries at 320 B.C.=4,380 years.

4,380 Sothic Years=3 Sothic cylces.

25 Sothic cycles= 36,525 vague years.

Phœnix cycles make up true period of Precession, 25,826½ years.

Phœnix cycle erroneously identified with Sothic cycle.

Hence false Phœnix cycles lead to period 36,525 years, being conceived as Precessional period.

¶ 106. PERIOD OF PRECESSION ALWAYS NUMERICALLY ASSOCIATED WITH BASE OF GREAT PYRAMID.

Apart, however, from the sequence noted, tradition obviously held that the true period of Precession was given by the Pyramid base, tradition failed to preserve the knowledge that the numerical value of the period was contained in the sum of the diagonals of the base square. The later Egyptians, therefore,

Tradition that Great Pyramid base gave true Precessional Period.

Identification with base diagonals lost.

[1]The basis of the calculations giving these dates, together with the whole question of the astronomical divisions of the Zodiac will be dealt with later.

Identification with base circuit adopted.

adopted the circuit of the base square as giving the period of Precession. They passed this period of 36,525 years on to the Greeks. The period is equal to an annual rate of Precession of 35.5 secs. of angle. Hence Hipparchus (circ. 150 B.C.) "determined" the rate of Precession as 36 secs. of angle.

How Hipparchus obtained his rate of precession.

The Nominal Solar Year, 365.24 days, recedes through the nominal Sothic Year, 365.25 days, in 36,525 years, giving a true application of Precession, but not an astronomical application.

The period was also reckoned as containing not only 25 Sothic Cycles, but 24 nominal Solar cycles of 1521.875 vague years. (Refer ¶ 59.) The nominal Solar year of 365.24 days was reckoned to travel completely backwards round the nominal Sothic year of 365.25 days in 36,525 years. The vague year also travelled backwards completely round the nominal solar year in 1521.875 vague years. This gives the complete explanation of the late conceptions concerning Precession.

Hence the system of Africanus (Plate XVI, Table A) gave the Divine and Human Dynasties as of the duration of 20 nominal solar cycles of 1521.8 years, or 30,437 years.

¶ 107. "PYRAMID" THE GRECIANISED FORM OF HEBREW "URIM-MIDDIN"—"LIGHTS-MEASURES."

Greek Science derived from Egypt and Chaldæa.

In section II of this chapter a synopsis of the evidences concerning the origins of Greek Science and Philosophy is given. The facts, and the sequence of facts, of this synopsis, clearly show that the Greek philosophers derived what was new and original in their science and philosophy from the oral traditions of the priesthood of Egypt and Chaldæa—but chiefly from Egypt. The same sequence of facts was seen in the case of the knowledge of the megalithic builders of the Mediterranean and Atlantic seaboards.

Zonares on Greek Arithmetic and Astronomy derived from Egypt and Chaldæa.

It was obviously of no recent derivation or migration of science that Zonares[1] wrote, in treating of arithmetic and astronomy, when he stated—

"It is said that these came from the Chaldees to the Egyptians, and thence to the Greeks."

Name "Pyramid" of Chaldæan origin.

Great Pyramid name in Egypt "Khuti"= "The Lights."

In Hebrew "Lights"= "Urim."

Chaldee "Ur" becomes Phrygian "Pur," Greek "Pyra" (pl.)= "Beacon Fires."

The truth in this remark is monumentally confirmed by the lasting name of the monument perpetuating the early knowledge to which Zonares refers. For the name "Pyramid"—like all the constructional conceptions embodied in the Great Pyramid—is primarily of Euphratean derivation. The Egyptian name for the Great Pyramid is "Khuti"—"the Lights." In the Semitic languages the equivalent name is "Urim"—"the Lights." In Phrygian and Greek, the root "Ur" (light) became successively "Pur" and "Pyr" (fire), and "Pyra" (a plural) "beacon fires."

Thus Plato, in his "Cratylus" (Taylor's translation), says, "Do you know on what account 'Pur' (Pyr) was so called? Consider whether this is not of barbaric origin—for it is by no means easy to adopt this to the Greek tongue; and it is manifest that the Phrygians thus denominate 'fire' with a trifling deviation." Thus 'Pur' (Pyr) is a form of the Hebrew 'Ur'—'light.' The

[1]Lib. I, vi.

addition of the labial 'p'—as also 'b' and 'f,' hence 'burn' and 'furnace'—is a frequent change observed in roots passing from one language to another. Hence 'Uri'='fiery.' Here both words contain the same original root.

Again in Hebrew, 'middin'='measures,' 'madadu'='to measure'; in Sanscrit, 'ma,' 'mad,'='to measure'; in Zend, 'meêtê,' 'matê'; Latin, 'modus,' 'a measure'; Greek, 'metron'; Anglo-Saxon, 'metan,' 'to measure.'

Hebrew "Middin"= "Measures."

Examples—'Aga-medes,' *Semitic*, 'The Great Measurer,' or *Greek*, 'the very wise' *Phoenician*, 'Baal-middoh,' 'the Lord of the measures.'

Phœnician "Baal-Middoh"= "The Lord of the Measures."

In Chaldee and Hebrew, 'Urim'='Lights,' with the labial 'p,' as in Phrygian, 'Urim'='Purim'='Lights.' Greek 'Pyra'='beacon fires' (lights).

In Chaldee and Hebrew, 'middin'='measures." Hence the Chaldee-Hebrew name for the Great Pyramid—in Egyptian, 'Khuti,' 'the Lights'—is 'Urim-middin' (Purim-middin)='Lights-Measures.'

Purpose of Great Pyramid defined in Hebrew by name 'Urim-middin'='Lights-Measures.'

In Greek this becomes 'Pyra-midos,' 'Pyra-mid.'

The name 'Pyramid,' therefore, monumentalises the external purpose of the Great Pyramid. It is a "beacon of reflexions," and a "monument of measures."

Grecianised form of name ='Pyra-middin,' 'Pyra-Midos,' 'Pyramid.'

It is of importance to observe that the Greek name is not derived from two Greek roots, but is the Grecianised form (Pyramidos) of the Semitic name 'Urim-middin,' or possibly of a composite Phrygian and Phœnician form of the name—'Purim-middoh.'

¶ 108. THE PYRAMID OF THE DYNASTOLOGICAL LISTS AND OF THE BOOK OF THE DEAD.

In the compilation of the ancient Egyptian King Lists, Egyptologists recognise three main periods when such compilations were made. These are, in order,

Egyptian Dynastological Lists:—

Three periods of compilation.

(1) The early period of Dynasties V–VI—e.g., the King Lists of the Stele of Palermo, and of the Cairo fragments. The kings of these dynasties built Pyramids at Abusir and Sakkarah.

(1) Dyns. V & VI

(2) The period of Dynasties XVIII and XIX—e.g., the Karnak List and the Turin Papyrus List (Dyn. XVIII), and the Lists of Abydos and Sakkarah (Dyn. XIX).

(2) Dyns. XVIII & XIX

(3) The Saïte Restoration Period—Dyn. XXVI—from the compilations of which period as we have seen, the Lists of Manetho were derived in part.

(3) Dyn. XXVI

In the evolution of the Egyptian Sacred writings, Egyptologists recognise three similar periods as follows:—

Egyptian Sacred writings:—

Three periods of compilation.

(1) The period of Dynasties V and VI, when the funerary texts, commonly known as the Pyramid texts, were carved. These deal with the life of the king in the future life. From them originated the later so-called *Book of the Dead*, chapters of which were in existence as early as the XIIth Dynasty.

(1) Dyns. V-VI

(2) The period of the XVIIIth to XXth Dynasties when the collection known as the Theban Recension of the *Book of the Dead* was prepared.

(2) Dyns. XVIII-XIX

(3) The period of the XXVIth (Saïte) Dynasty, when the Saïte Recension of the *Book of the Dead* was compiled.

(3) Dyn. XXVI

The Egyptian "Book of the Dead" employs Great Pyramid features as an allegory of the future life.

To the latter recension belongs the version entitled "The Book of the Master of the Hidden House," in which, as Mr. Marsham Adams[1] has shown, the soul of the departed is pictured as following the passages and chambers of the Great Pyramid. In this version the Pyramid itself is pictured as an allegory in stone of the ways and trials of the future life.

¶ 109. THE SECRET HOUSE OF THE SAÏTE RECENSION.

Maspero's opinion:—

Purpose of Pyramids and Book of the Dead related.

As a result of Mr. Adams' researches, Sir Gaston Maspero concluded that "The Pyramids and the '*Book of the Dead*' reproduce the same original, the one in words, the other in stone."[2] In quoting the preceding, Mr. Adams refers to "the prevalence of a tradition among the priests of Memphis," a fact which he says he "learned later from the same authority," supporting his "contention that the Secret House was the scene where the neophyte was initiated into the mysteries of Egypt."

Egyptian efforts to refer back sacred writings to Pyramid period.

Accordingly every possible attempt was made by the compilers of the various chapters of the *Book of the Dead* to refer back the origin of the ritual and symbolism to the Pyramid Kings of Memphis—the builders of the Pyramids of Gizeh. Thus a passage in the cxxxviith chapter of the *Book of the Dead* states that that chapter was found by Heru-tat-ef, son of Khufu, the builder of the Great Pyramid.

Significance of attempt of XXVIth Dynasty to ape the customs and institutions of Pyramid period.

Now it was during the XXVIth (Saïte) Dynasty that the order of chapters of the *Book of the Dead* was drawn up, and when, as Breasted states,[3] "the worship of the (Pyramid) kings, who had ruled at Memphis in these remote days, was revived.....Their Pyramids were even extensively restored and repaired. The archaic titles.....in the government of the Pyramid builders were again brought into requisition, and in the externals of government everything possible was done to clothe it with the appearance of remote antiquity."

Dynastological Date for Origin of Dynasty XXVI is numerically the arc of 36,525 circle giving Pyramid Angle of Slope.

Hence in the Saïte system of Dynastology, preserved in the version of Africanus, the duration of years stated to Psammetichos, the first actual king of Dynasty XXVI (Saïte), is given as 5,271, the length of the arc of the 36,525 circumference, measuring the angle of slope of the Standard Pyramid. Reduced to modern angular measure this angle of slope is 51°–51′–14″.3, the angle of slope of the Great Pyramid of Gizeh.

It was during the reign of Psammetichos (Psamtek I)—as Herodotus states—that Greek colonists first settled in Egypt.[4] For the significance of this settlement, and its date in relation to the history of Greek Geometry and Astronomy, the reader is referred to Section II of this chapter, and Table X.

[1] "The Book of the Master," by Marsham Adams.
[2] Quoted from a letter to Mr. Marsham Adams, "The Book of the Master," p. iv.
[3] A History of Egypt, p. 570.
[4] Refer Annals of Assurbanipal re Gyges and Lydians. This gives the date as 661 B C., when the Carian colonists of Herodotus apparently accompanied the Lydians as mercenaries.

¶ 110. COPTIC CHRISTIANITY AND "THE BOOK OF THE DEAD."

The Ancient Mystery of the Pyramids.

Thus it is that from the remotest periods of authentic history, an atmosphere of mystery has enshrouded all expression of thought and opinion concerning the Pyramids of Gizeh. Essentially geometrical in form, the Pyramids, by influencing the expression of theological conceptions, supplied religious allegory with an unfailing source of geometrical symbolism. It is this pyramid allegory of which a corrupt survival exists in the Egyptian *Book of the Dead.*

Survival in Book of the Dead.

"The Book of the Dead" influences Coptic Christianity and Early Christain Gnosticism.

It is from the *Book of the Dead* that the Coptic descendants of the ancient Egyptians derived the mystical and allegorical element which was introduced into early Christian gnosticism. The literature of early Christian gnosticism abounds in mystical pyramid figures and associated astronomical conceptions and constellations.

The Importance of Coptic in assisting to solve the problem of the Ancient Egyptian Language.

To the Copts is due the survival, to the present day, of the ancient Egyptian Calendar and month names. To them we owe the retention of a dialect of the ancient Egyptian language, and with it, much that has tended to facilitate and elucidate the translation of ancient hieroglyphic texts. Hence the importance and value attaching to any traditions concerning the Great Pyramid that can be reliably identified as of Coptic origin.

¶ 111. COPTIC TRADITION AND THE GREAT PYRAMID.

Coptic Traditions concerning the Pyramids and their purpose.

Regarding the Coptic traditions, Dr. Sprenger, in Appendix to Vyse's "Pyramids of Gizeh," vol. II, observes that "the traditions of the ancient Egyptians were preserved by their descendants, the Copts, who were held in great esteem by the Arabs.....It may be remarked that the Arabian authors have given the same accounts of the Pyramids, with little or no variation, for above a thousand years ; and that they appear to have repeated the traditions of the ancient Egyptians, mixed up with fabulous stories and incidents, certainly not of Mahometan invention."

Arabic MSS. Translations of Early Coptic MSS. concerning the Pyramids.

The account of Masoudi (died 345 A.H.=957 A.D.), in the Arabic MS. of the Akbar-Ezzeman, at Oxford, relates that "Surid .....one of the kings of Egypt before the flood, built the two great Pyramids." In this narration the Great Pyramid is referred to as "the Eastern Pyramid." Dr. Sprenger states that "Masoudi affirms, in the Akbar-Ezzeman that he wrote his account of Surid from a Coptic modern history."

The narration of Masoudi is as follows :—

The Great Pyramid :— Contained Records of Arithmetic and Geometry.

".....He (Surid) also ordered the priests to deposit within them (the Pyramids), written accounts of their wisdom and acquirements in the different arts and sciences.....with the writings of the priests containing all manner of wisdom, the names and properties of medical plants, and the sciences of arithmetic and geometry, that they might remain as records, for the benefit of those who could afterwards comprehend them."

Astronomical and Historical Cycles affecting past and future time.

"..... In the Eastern Pyramid (the Great Pyramid) were inscribed the heavenly spheres, and figures representing the stars and planets...."

"The king, also, deposited..... the positions of the stars and their cycles; together with the history and chronicle of time past, of that which is to come, and every future event which would take place in Egypt."

Great Pyramid Dedicated to History and Astronomy.

Similarly the MS. of Makrizi states that "the first (the Great) Pyramid was especially dedicated to history and astronomy; the second (Pyramid) to medical knowledge."

Tohfat Alagaib states that the Great Pyramid contained "plans of the stars, and historical and prophetic records."

¶ 112. THE SOURCE OF COPTIC TRADITIONS.

According to the accounts of Masoudi and Al Kodhai, a papyrus, found in the monastery of Abou Hormeis, and said to have been inscribed with ancient "Coptic" characters, gave the following account of the Pyramids:—

"Upon the walls were written the mysteries of science, astronomy, geometry, physics, and much useful knowledge, which any person, who understands our writing, can read."

Coptic Traditions erroneously identified the pictured Pyramid Passages of "The Book of the Dead" with the Passages of the Great Pyramid.

The Pyramids of Gizeh, we know, contain no such hieroglyphic inscriptions as the traditions imply. It is only such texts as that of the *Book of the Dead*, which picture the passages and chambers of the Standard Pyramid of the Dynastological Lists, or Secret House of the *Book of the Dead* as lined with instructions and formulæ, and with mythical figures and stars. It is to these that the traditions refer, and from such texts as these that the traditions obtained authority for identifying the Standard Pyramid of the Dynastological Texts with the Great Pyramid of Gizeh.

Importance of Coptic Traditions:— Association of Sacred House of the "Book of the Dead," and the Standard Pyramid of the Dynastological Lists, with the Great Pyramid

The fact therefore remains that Coptic tradition associates the Great Pyramid with the symbolising of astronomical and geometrical figures, just as the Egyptian Ancestors of the Copts associated the Great Pyramid with their ideal secret house in the *Book of the Dead*, and with their geometrical Dynastology, cosmical year circle, and Sothic cycle mythology.

Section I—Summary and Conclusions.

¶ 113. PREVIOUS CONCLUSIONS AND NEW DATA.

Thesis that a "Prehistoric" Civilization reached same advanced stage of astronomical knowledge as Modern Science of Gravitational Astronomy.

In the Summary and Conclusions of Chapter I (Section I, ¶¶ 40–46), it was seen that a high state of civilisation flourished in times classified as "prehistoric." The culture of this civilisation was seen to have reached an advanced stage of scientific knowledge. It was not suggested that scientific development had proceeded along the same lines as modern scientific research.

Not necessarily on same lines or research.

It was, however, suggested, *by the evidence*, that results had been attained in the science of astronomy in no way inferior to the results of modern gravitational astronomy.

In one particular line of inquiry, the indications pointed clearly to an advanced knowledge concerning the elements of the planetary orbits. These indications suggested that this knowledge had been recognised to be capable of simple expression as a system of Natural Law; the system being capable of complete definition in solid geometrical form. This was indicated as of Pyramidal form.

"Prehistoric" Knowledge concerning Elements of Planetary Orbits.

Embodied in a system of Natural Law defined in solid geometrical form.

The evidence discussed afforded reliable grounds for tentatively accepting the hypothesis that the Great Pyramid of Gizeh was the structural expression of this system of Natural Law. It suggested that the Pyramid was constructed to perpetuate this knowledge at a time when the remote founders of the Euphratean, Egyptian, and Mediterranean civilisations were reconstructing their systems of national life upon the fragments of oral tradition remaining from the former civilisation.

Great Pyramid a structural expression of this.

Its construction a link between the "Prehistoric" civilisation and the beginning of Historical civilisation

The discussion of the new evidence adduced in the present chapter indicates that the hypothesis suggested by the preliminary data is confirmed by the oral traditions concerning the Great Pyramid, by its association with the original scientific system of primitive measures, and by its external measures and principal features.

New Data concerning Systems of Measures, Oral Tradition, and External Measures of Great Pyramid confirm thesis.

¶ 114. A POLAR DIAMETER INCH.—ACCIDENT OR INTENTION.

The evidence upon which the preceding conclusion is based leads to the further inference that the *external features* of the Great Pyramid are primarily concerned with a geometrical representation of the dimensions and motions of the Earth and its orbit. The unit for the geometrical representation of dimensions must necessarily be a simple function of (a) the Earth's Polar diameter, (b) the Sun's diameter, or (c) the Earth's mean distance from the Sun. Otherwise the representation can have no meaning or application. It seems to be clearly evident that of the three possible units that derived from the Earth's Polar Diameter is the most suitable for representing the other two dimensions in terms tangible to the Earth's scientific inhabitants.

Necessary Basis of Ancient Science a Knowledge of Length of Earth's Polar Diameter.

Intentionally, or by accident, the Great Pyramid unit of measurement—the Primitive inch—is the simplest possible function of the Earth's Polar Diameter. The Earth's Polar Diameter measures exactly 500 million Primitive inches. The value giving this result was derived from three independent sources:—

Primitive Inch, Great Pyramid Inch, and Inch defined by Egyptian King Lists are all equal.

500 Million of such inches = Earth's Polar Diameter.

(a) The common sources of Egyptian metrological data (¶ 81).

(b) The ancient Egyptian Dynastological Lists (¶ 94).

(c) The external measurements of the Great Pyramid (¶ 101).

The three independent sources agree in associating the Primitive inch value with the representation of cyclic functions of the Earth's motion in its orbit. This tends to confirm that the simple relationship between the Earth's Polar Diameter and the Primitive inch can scarcely have been an accidental

Associated Data indicate Relationship as possibly intentional.

Requisite Additional Data to establish intention :—

Association with simple relationships, Sun's Diameter, Mean Sun Distance, Orbit Eccentricity, and variations.

Independent Angular Check Measurements

relationship. It cannot, however, be established that the relationship was intentional until the Pyramid's geometrical system is shown to extend the relationship to the Sun's diameter, the mean Sun distance, and the variations in the eccentricity of the Earth's orbit. These values should be confirmed, as to intention, by the representation of *independent* heliocentric or geocentric angular measurements where possible. At least, this is what one would expect to find in a geometrical system of the nature inferred, and in which the Designer's express purpose was to establish the certainty of his intentions.

¶ 115. THE PRIMARY METROLOGICAL SYSTEM.

The Sacred Hebrew Cubit, of 25 P. inches, preserved by Pyramid and Hebrews.

Never used in Egypt except by Semites.

The Primitive inch—the inferred Polar diameter inch—is the basal unit of the Primary Metrological system of the former civilisation. An important unit of this system was the Sacred Cubit of 25 P. inches. The latter has been preserved by the measurements of the Great Pyramid, and by the Hebrews. It never occurs in Egypt except during periods of Semitic domination.

The Sacred ½-Cubit originates the Modern Foot.

Apparently from the half cubit ($12\frac{1}{2}''$) of this system originated the $12\frac{1}{2}''$ foot of ancient Roman remains, and of ancient British and Medieval English remains. Of the same origin is the old Rhineland foot, and the foot in Switzerland and Austria.

The Primitive Inch originates the Modern Inch, Zoll, Tum, and Pouce.

The Primitive inch (1.0011 B″) is also the original of the British Inch, of the old German, Austrian and Swiss *Zoll*, of the Danish *tomme*, and Scandinavian *tum*, and of the old French *pouce*. This origin, at least for the British Inch, is confirmed by the connection between the sacred half-cubit and the decimal division of the Hebrew unit of 10 acres in ancient Cornwall, where the side of the 10 acres square occurred as a furlong of 8,000 inches. (¶¶ 85 and 86.)

¶ 116. THE SECONDARY METROLOGICAL SYSTEM.

Secondary Metrological System devised to Avoide use of π.

Its basis the Year Circle

Diametric and Circumferential Units, and Linear Units for Areas.

The Secondary Metrological System of the former civilisation is very clearly defined. It appears to have been formulated to avoid in calculations the use of the ratio, $\frac{\text{circumference}}{\text{diameter}} = 3.14159$. A Standard Year Circle of 3652.42 Primitive inches was adopted. The Standard Diameter of this circle was divided into Diametric Digits, Diametric Feet, and Diametric Cubits. The Standard Circumference was divided into Circumferential Digits, Circumferential Feet, and Circumferential Cubits. These linear units have all been preserved by the Egyptians.

The Origin of the Unit of Square Measure

The "Aroura."

The "½-Aroura" Year Circle.

A standard of Square Measure was formulated as follows :—A Rectangle of length equal to the circumference of the Standard Circle, and of breadth equal to the diameter of the Standard Circle was the standard unit of square measure. It was equal in area to the area of four standard Circles. The Standard Rectangle was transformed into a square of equal area. The side

of this square was divided into a hundred parts. The linear unit thus obtained was adopted as the cubit for measuring sides of rectangular figures. This cubit has been preserved by the Egyptians as their common cubit of 20.63 British inches.

The "Aroura" Rectangle and "Aroura" Square.

The Common Egyptian Cubit.

Simple rule-of-thumb relations connected the diametric and circumferential units with the linear units of rectangular figures. The Secondary system was obviously formulated at a time when the uncultured many were organised to carry out highly skilled work under the intermittent direction of a cultured few. The system appears in use in ancient Egypt in the earliest Dynastic times—and possibly in pre-dynastic times—before the Pyramids were built.

System for use of the Uncultured Many under Intermittent Direction of a Cultured Few.

System in use before the Pyramids.

¶ 117. THE GREAT PYRAMID'S EXTERIOR.

In Chapters III and IV it will be seen that the Great Pyramid contains a single comprehensive system of geometry representing the complete derivation of the Secondary System of Measures in terms of the Solar year to the scale of 1P. inch to a day. From this, and the data in the present chapter, it follows that the Great Pyramid represents the geometry of the year circle to three decimal scales,

The Great Pyramid's three scales

1

10

100.

(a) 1 P. inch to a day. (Plates XXXV and XLIII.)
(b) 10 P. inches to a day. (¶¶ 95 and 99.)
(c) 100 P. inches to a day. (¶¶ 100 and 101.)

Its 35th Course defines the Rectangular "Aroura."

Its 35th course defines the Sacred Cubit of 25 P. inches, and the *aroura* rectangle of 3652.4 P. inches by 1162.6 P. inches. The Square circuit of *any* horizontal plane of the Pyramid is equal to the circumference of a circle of radius equal to the Pyramid height above the horizontal plane considered; and the area of the right vertical section of the Pyramid above this horizontal plane is equal to the area of the quadrant of the circle defined.

Pyramid's Horizontal Circuit= Circumference of Circle whose Radius equals Pyramid height above Circuit considered.

The datum of this representation is the Pyramid's base circuit of 36524.2+P. inches, representing the value of the solar year on the scale of 100 P. inches to a day.

Pyramid's Base Circuit = 36,524 Primitive inches.

¶ 118. THE EGYPTIAN KING LISTS DEFINE THE GREAT PYRAMID.

It was at a comparatively late period of Egyptian history that the Egyptians constructed their various systems of fictitious chronology. This they did by substituting years of alleged Egyptian history for Pyramid inches in important measurements of the Great Pyramid. The principle upon which they proceeded in such cases was outlined by Dr. Sprenger about a century ago. Sprenger stated, regarding the Egyptians, that, with them, "an idea, a period of time, or any remarkable occurrence, were frequently connected with ideal persons in mythology, and when any similarity existed, received the same appellation."[1]

Fictitious Chronology of Egyptian King Lists compiled from Great Pyramid's Measurements.

Sprenger defines factors governing such fictitious compilations of Egyptians.

[1]Vyse's "Pyramids of Gizeh," Vol. II, Appendix.

The factors in the case of the Mythical Chronology of the King Lists.

"The idea" in the particular case under consideration was that oral tradition associated the Pyramid's measures with astronomical cycles and orbital motions. This supplied the data for their various "periods of time," and for identification with "remarkable occurrences" in history and astronomy.

Supposing that Great Pyramid had been demolished, its principal Features, Dimensions, and its Units could be reconstructed from the Egyptian King Lists.

So extensively did the Egyptians adopt the outstanding measurements of the Great Pyramid in their fictitious systems of chronology that the Great Pyramid's external *features*, *dimensions*, and *units* can be derived without any prior reference to the Great Pyramid. Were the Great Pyramid not now in existence its external form, dimensions, and units, together with its principal external features, could be reconstructed entirely from the Dynastological Lists of the Egyptians.

¶ 119. THE KNOWLEDGE IN THE KING LISTS AND THE LACK OF UNDERSTANDING.

Analysis of Pyramid Data of King Lists indicates that the Later Egyptians knew the general purpose of the Pyramid, but were unable to give expression to this purpose in detail.

The unsystematic manner in which the Egyptians adopted Pyramid measurements as the basis of astronomical periods in their King Lists clearly indicates that they had nothing but a general vague tradition to guide them. They proceeded to extract measurements without regard to sequence or principle. Scientific principle demands that a graphical representation of a period of time cannot be made along an axis defining radii and diameters, and at the same time be made round a circuit defining a circumference. The latter method of representation is possible, the former unlikely, but both together are impossible in a scientific representation.

They knew Base defined Precessional Period, but identified same with Base Circuit instead of Base Diagonals

The compilers of the King Lists, however, added the measurements of radii to the measurements of arcs, horizontal distances to vertical distances, and totalled measurements in cubits together with measurements in inches. The single idea they did adhere to was that the Pyramid base circuit contained a representation of the Period of Precession. One school adopted the sum of the base diagonals as giving the period in inches for years. Another school adopted the base circuit in inches for years, as defining the Period. The difference between the two conceptions amounted to 10,698 years, or twice the duration of the human kings given in one summation of the Lists preserved by Africanus. (Plate XVI, Table C (4).)

Other items of knowledge preserved intact but without intelligent understanding.

Nevertheless, in their oral tradition, possibly without much understanding of the facts, the Egyptian priests retained many valuable items of astronomical knowledge. This is indicated by the manner and sequence in which the Greeks derived their knowledge of science from the Egyptians. (Refer Section II of this Chapter—and Table X.)

¶ 120. THE SUGGESTED LINES OF FURTHER INQUIRY.

New Data suggest that Pyramid Base and its features should define not only the Tropical (Solar) Year but the Siderial Year.

The traditional association of the Pyramid's base with the idea of Precession leads to a further possible inference. The difference between the solar year and the siderial year is the annual amount of precession measured in time. This and the Pyramid base connection suggest that while the base square circuit gives the value of the Tropical year, the perimeter of the hollowed-in base may have been intended to give the value of the Siderial year.

Development of Inquiry suggested supplies more confirming Data than suggestion indicated.

By following up this suggestion, the reader will find the intention of the Pyramid rapidly developing in Chapter III. From this suggestion, the external features, dimensions, and units of the Great Pyramid, when *studied in plan*, will be found to give, precisely and accurately, every essential value of the Earth's orbit, and its motions. These will be found to include the values of the Anomalistic, Siderial and Solar years, the mean Sun distance, the Sun's diameter (independent linear and angular representations), and the maximum and minimum values of the eccentricity of the Earth's orbit.

The Further Data throw light upon the origin of the Pythagorean system of Astronomy.

From these representations the reader will be able to appreciate how and why Pythagoras—having studied the science of the Egyptians—was enabled to enunciate, over 2,000 years before the truth was generally realised, that the planets revolve round the Sun. (Refer Section II, ¶¶ 126 and 129 to 133, and Table X.)

SECTION II.—THE ORIGINS OF GREEK GEOMETRY AND ASTRONOMY.

¶ 121. THE ANCIENT MYSTERIES OF ORIENTAL CULTS.

Ancient Knowledge preserved by oral instruction.

Oral instruction was the means of perpetuating the knowledge preserved by the cults of the ancient East. Hence we find, in both Egypt and Chaldæa, much monumental and other structural evidence of a higher knowledge, but no literature with regard to its principles and essential details. Literature there is, of a kind, as we have seen in the cases of the Egyptian Dynastological Lists, and the Book of the Dead. In general—as in the cases cited—it is the literature dispensed by the priesthood for the mystification of the laity, or at best, the coded literature beloved of the mythologist and kabbalist, to understand which required oral instruction by admission into the several orders of the cult, and, for a complete unveiling, admission into the ultimate Inner Priesthood.

Hence paucity of direct literary reference.

Ancient Literature purposely distorted the facts of knowledge in form of a Priestly Code of Reference

Analysis of such records indicates that Codes preserved the Central Facts of Ancient Knowledge without preserving understanding of the derivation and application of the facts.

The explanation of phenomena and ideals furnished by the popular literature were generally distorted and untrue. Furnished by the coded literature, the explanations were so hedged about by intentional obliquities, so obscured by fables and spurious mysteries, and so entangled in its code, as to be beyond the comprehension of those without the cult. The evidence discussed has shown that such explanations, when made, did not give an understanding of the ancient science. They merely revealed the traditional knowledge concerning the facts that had been derived from a former understanding of the causal relation between the facts and the scientific phenomena expressed by them.

¶ 122. KNOWLEDGE PRESERVED AS A MYSTERY: UNDERSTANDING LOST.

Distortion of Facts extended to Art.

With such an artificial basis for the national ideals, art itself became distorted in its representation of such phenomena as the heavenly bodies and their motions—apparent or real. This distortion was maintained even in the coded literature that formed what we may term the index of reference for the priests of the Inner Mysteries. Hence we find that in Chaldæa, and still more particularly in Egypt, the scientific knowledge retailed by the priesthood, for use and application in the national life, had been filtered down to "rule-of-thumb" dogmas, and rough empirical axioms, postulates and formulæ.

Utilisation of Facts of Knowledge controlled by Priesthood.

Empirical Rules "Rationed" out to Populace.

The mistake of supposing that the Empirical Rules indicate extent of knowledge possessed by the Ancients.

In reiteration of such dogmas and empirical formulæ the monuments, papyri and traditional literature are clamourously persistent. The approximate nature of these rules is so evident that it has become the custom to pass unchallenged the assertion that the ancient Egyptians and Chaldæans performed their vast and accurate engineering and other scientific works upon a purely empirical and "rule-of-thumb" basis.

The hypothesis underlying this assertion is not only illogical; it is not in accordance with what we know regarding the relations between State and Priesthood.

¶ 123. THE SUPPRESSION OF LEARNING.

Priesthood organised its knowledge and resources to control machinery of State.

The Priesthood saw in the State the means whereby it could obtain power, possessions and obedience. Accordingly, the priesthood centred its efforts and organised its resources and knowledge towards obtaining control of the machinery of State. Its object was so to formulate the constitution that the State should be dependent upon the Priesthood.

Priesthood possessed the Exclusive knowledge of fundamental principles of Almanac Organisation, and of constructional and other scientific works.

The Priesthood possessed the knowledge necessary for almanac organisation and the scientific knowledge embodied in the vast engineering and other scientific works carried out by the State. That knowledge was given no clear literary expression, lest the State, by possession of this, should become independent of the Priesthood. Hence it is obvious that the few empirical rules, of which the monuments and papyri give us evidence, were vastly less than the unwritten knowledge of the silent Inner Priesthood.

Conditions devised and enforced to ensure that the nation must rely upon the informed guidance and judgment of the Priesthood.

Schooled to dependence upon the Priesthood, the ancient Egyptians, and to a less extent, the ancient Chaldæans, made little or no independent attempt to seek the first principles underlying the empirical rules retailed by the Priesthood. The extent of this dependence—or rather, the extent to which this dependence was enforced—is illustrated by the enforced legalisation in Egypt of the vague or shifting year.

In Chaldæa a similar process was effected by means of the authority of the astrological texts, defining the supposed causal relations between the acts of kings, princes, and populace, and the produce and other phenomena of the seasons.

¶ 124. STATE-CONTROL IN ANCIENT EGYPT.

The Vague Year and the Calendar Seasons.

With the institution of the vague year in Egypt, the Priesthood brought into being a new process of State control. The vague year thereafter carried the calendar seasons backwards round the Solar year. The Calendar Seasons came to have no meaning. The knowledge of the accurate recurrence of times and seasons was confined to the rulers and priests of the Solar deities. Only by giving abundance of gifts to the solar gods could the husbandman be assured of a plentiful harvest. A system of State-control was thus established whereby wealth accrued to state and priest craft, and ultimate responsibility was referred to the gods. A goodly harvest implied that the gods were pleased; a poor harvest that the gods were dissatisfied with the offerings of the people. State and priesthood might receive reflected glory; never blame.

State Control of the Year and Agriculture.

The Gods Responsible

The people responsible to the Gods.

State and Priesthood absolved.

¶ 125. THE DISTORTION OF KNOWLEDGE LEGALISED.

The Solar Deity as formal cause.

All common rules of life and things material were ultimately depicted as having conception and source in the life-giving rays of the sun. The sun, from the XVIIIth Dynasty onwards, whatever the deity with which it was identified,

was the great Formal Cause, which by means of its seasonal phenomena of the year, and the dependent phenomena of Nile inundation, made Egypt " the gift of the Nile."

The Cyclical Basis of the Solar Cult.

The theogony and cosmogony of the ancient Egyptians were, in consequence, formulated on a cyclic basis having its origin in the value of the year. This was already expressed in the Pyramid's geometry of the year circle. The numerical functions of this geometrical scheme were diverted by the priesthood into the channels of State-control, and were applied to the measurement of all effects attributed, by the Priests, to the influence of the Solar deity, Amen-Ra.

Fabulous Chronology and Pyramid Year Circle Geometry.

As a crowning monumentalisation of the omniscience of Amen-Ra the whole history of the Divine and Human Dynasties of Egypt was built around a fabulous chronology composed of nominal solar and Sothic cycles, and numbers of years that were in reality but geometrical functions of the Pyramid, and its year circle and astronomical cycles.

The absorbed cults responsible for differing versions of the Dynastological Lists.

Many of the old cults absorbed by the dominant cult of Amen-Ra still partly retained their individuality by worshipping their original gods under the aspect of the leading attributes of Amen-Ra. This was the effect intended, but owing to this fact, the Egyptian Lists contain differing versions of the mythological chronology of the year circle and its Pyramid functions applied to the Divine and Human Dynasties.

¶ 126. THE PARTIAL UNVEILING OF THE MYSTERIES OF EGYPT.

Independent thinkers of Greece glean scientific information from priests of Egypt.

Egyptian Priests reluctant to impart information.

Pythagoras derives data for his Philosophical System and for his scientific systems of astronomy, numbers, geometry, and music from Egyptian Priests.

It was only after the seed of freedom, sown by the rising Greek nations, had produced independent philosophers, and when these philosophers had commenced to visit the Egyptians and Chaldæans, that the meagre information gleaned from the priests and independently derived from the empirical rules, was reduced to its crude Greek first principles. Thus, Professor G. Forbes states that " the Egyptian priests tried to keep such astronomical knowledge as they possessed to themselves " ; and, as indicating the reluctance with which they parted with information, Sir G. Wilkinson states that " Iamblichus says Pythagoras derived his information upon different sciences from Egypt ; he learnt philosophy from the priests ; and his theories of comets, numbers, and music were doubtless from the same source ; but the great repugnance evinced by the Egyptian Priests to receive Pythagoras, will account for their withholding from him much that they knew, though his great patience, and his readiness to comply with their regulations, even to the rite of circumcision (Clem. *Strom.* i, p. 302) obtained for him more information than was imparted to any other Greek (Plut. *de Is.* s. 10)."

In light of the facts we now possess from the monuments, the ancient accounts of the sojourn of Pythagoras in Egypt picture him as a skilful cross-examiner eliciting information from a reluctant Priesthood. We can picture the Egyptian Priests striving to impress Pythagoras with the vast extent of their own learning and at the same time seeking to obscure the real facts—and their ignorance of the derivation of the facts—by dogmatic and mystifying assertions. Nevertheless, their long association with a credulous and easily satisfied laity ill fitted them for dealing in debate with an intellect so original, independent, and penetrating as that of Pythagoras.

Pythagoras a skilful cross-examiner pandering to the vanities of the Egyptian Priests, and conforming to their rituals, painstakingly extracts from their veiled admissions scientific facts of priceless value.

¶ 127. THE HELLENIZING OF EGYPT. 7TH CENTURY B.C. TO 7TH CENTURY A.D.

Coincident with the political and commercial rise of the Greek States, and the development of Hellenic science and arts, we can trace the decline, politically and commercially, of Egypt, and the accelerated decadence of Egyptian science and art. Greek philosophers hastened to absorb the virtues of the dying race—and many of its vices. Greek mercenaries, from the middle of the 7th century B.C. onwards, found military employment in Egypt. Pandering to the cults, the Greeks gradually undermined, throughout a succession of generations, the basis of the Egyptian national constitution. Slowly they Hellenized a nation for whom Hellenism meant disintegration.

Rise of Greek States coincident with decline of Egypt.

Period of close intercourse between Greeks and Egyptians.

The peaceful penetration of Egypt by the Greeks.

After the conquest of Egypt by Alexander the Great, the Greeks monumentalised their indebtedness to the Egyptians in the sciences and arts, by founding, during the reign of Ptolemy I, the famous library of Alexandria. From this age onwards, a long succession of Greek geometers, astronomers and philosophers, in the various schools of Alexandria, maintained the connection that previously had been more remotely held. Here all the learning that was gleaned and developed from the priests of the dying cults was reduced to literary form and method. Ultimately, however, in the age of Theon, and his daughter Hypatia, the schools themselves declined by falling completely under the pernicious spell of Egyptian dogma. In 642 A.D., the famous library was burnt by the orders of the Caliph Omar.

Alexander conquers Egypt.

Founds Alexandria.

Alexandrian Greeks found Astronomical, Geometrical and Philosophical Schools and the great Library of Alexandria.

Knowledge gleaned from oral tradition of Egyptian Priests reduced to system in writing.

"A cloud of witnesses" says Mr. R. Brown, Junr—in his "Primitive Constellations"—"testify to the connection between the wisdom of the East and the earlier sages of Hellas. The treasures of the library of Alexandria, the lore of such Chaldæan sages as Kidén, Naburianos, and Soudinos (*vide Strabo*, XVI, i, 6) were at the service of Hipparchus"; and again, quoting from the Scholiast on Aratos (*Diosèmeia*. 21) "the Hellenes received them from the Egyptians and Chaldæans."

Alexandria the Treasure City of the Wisdom of Egypt and Chaldæa.

¶ 128. THE SIGNIFICANT CONTRAST IN GREEK PRESENTATION OF SCIENCE.

Greek Scientific inquiry began in Egypt with XXVIth Egyptian Dynasty, which attempted restoration of cults and constitution of Pyramid Times.

The almost spontaneous rise and rapid development of Greek science date from the period during which Greek philosophers first visited Egypt. This dates back to the middle of the 7th century B.C., when the XXVIth Egyptian Dynasty began, and asserted its supremacy after the withdrawal of the Assyrians. At this time we saw that the Egyptians attempted a tawdry restoration of the manners, customs, arts, and sciences of the Pyramid age (¶ 109).

Sharp Contrast in presentation of Egyptian Science as given by the Greeks:— Advanced Scientific facts enunciated. True first principles of these necessary for their discovery. Greeks explain the facts as derived from puerile first principles— clearly invented to meet contemporary criticism.

The " discoveries " of the Greek philosophers dating from this age can be definitely divided into two classes. These are divided by the clearly marked sharpness of contrast in passing from one class to the other. On the one hand there are enunciations that are certainly the result of mature thought and experienced observation during a long succession of trained philosophers. On the other hand, enunciations, clearly the result of less mature thought, and of less experienced observation—more pertaining to the environment one would associate with a nation's first crude gropings amongst hypotheses of science—were claimed as equally great discoveries of the same philosopher.

Thales describes Lunar eclipses correctly. Yet indicates his ignorance of the essential First Principles by stating that the Earth floats on water.

Thus Thales of Miletus—the first of the Greek philosophers to visit Egypt for scientific instruction—while stating that the eclipses of the moon were caused by the earth cutting off the sun's light from the moon, indicated his own ignorance of the necessary advanced conceptions for arriving at this conclusion, by stating that the earth floated upon water. As to the extent of his experience, prior to his visit to Egypt, that is given by Hieronymus of Rhodes in his statement that Thales " never had any teacher except during the time he went to Egypt and associated with the Priests." (*ap. Diog. Laer.* I, 27).

¶ 129. THE LEARNED EVASIONS OF PYTHAGORAS.

The Advanced Planetary system of Pythagoras. Its Modern Counter-part. Absurdity of " First Principles " alleged by Pythagoras as basal premises of his system. Their similarity to the mystifying dogmas of Egyptian Priests. The advanced Planetary System calls for advanced first principles.

Pythagoras of Samos, who next of the Greek philosophers visited Egypt, stated that all the planets revolved around a common centre. This was not accepted by scientific circles in Europe until 2,000 years later. Pythagoras, however, indicated the vast unlikelihood of his having originated this conception by claiming to have deduced his system from " fantastic first principles, of which the following are examples: ' The circular motion is the most perfect motion,' ' Fire is more worthy than Earth,' ' Ten is the perfect number.' "[1] These so-called " first principles " bear a striking resemblance to the mystifying dogmas retailed by the Egyptian Priests—or to the catchword oratory of a modern type of aspirant to state-control—chanted to satisfy inquiring reason by voluminous reiteration rather than by wealth of argument. It is clear that the true first principles were as much the product of the same advanced state

[1]Professor G. Forbes, " History of Astronomy," p. 14.

of knowledge as the advanced planetary hypothesis immediately deduced from them, and that these advanced first principles were quite unknown to Pythagoras, and possibly unknown to his Egyptian instructors.

That the latter were unknown to Pythagoras indicates system was not deduced by him.

However this may be, it seems clear enough that Pythagoras derived his system from the Egyptian Priests. It is certain that the latter were, for many centuries, the custodians of much valuable scientific knowledge. This they explained on premises palpably absurd, but admirably adapted to suit the end they had in view.

His system derived from Egypt.

Had been preserved by Egyptians but not deduced by them.

¶ 130. THE LOST ART OF NUMERICAL AND GEOMETRICAL EVALUATION.

The religious and philosophical conceptions preserved by the Egyptian Priests were similarly expressed by them in geometrical and numerical forms that appear in no wise to suggest the symbolic use to which they were put, but appear rather to suggest the traditional survival of a symbolism of which the art was lost.

Association of Philosophical Conceptions in Egypt with Geometrical and Numerical Ideas indicates the survival of an Ancient Symbolism.

Now it is a fact that *there is* a geometrical or numerical basis attaching itself to most natural phenomena. We have merely to cite Kepler's Laws of the planets, Newton's Gravitational Laws, or Einstein's Laws of Relativity (including Newton's Laws in the same mathematical category as the Laws of other branches of Physics). There are also the complicated mathematical series associated with the formation of flower petals, and certain microscopical growths, and the marvellous geometrical forms of snowflakes and crystals.

The Geometrical and Numerical Bases of Natural Law.

Physics, Chemistry, Gravitational Astronomy, Botany, Biology, and Crystallography.

We are carried further in this subject by investigation of the Periodic Law of the Chemical Elements (and the connected periodicities of Isotopy), Radio-activity, the Electronic Theory of Matter, Harmonics, etc.

The Periodic Law of the Chemical Elements

Isotopy

Radio-activity.

¶ 131. BODE'S LAW.

A close approximation to numerical harmony occurs in the case of the planetary distances from the sun. This relationship is expressed by the series of Bode's Law—0, 3, 6, 12, 24, 48, 96, 192, 384, where 0 is the origin at Mercury. On this scale of relative distances, Mercury is distance 4 from the Sun. Adding this to the series given, the relative distances from the Sun are, according to Bode's Law :— 4, 7, 10, 16, 28, 52, 100, 196, & 388, the real distances being

3.9, 7.2, 10, 15.2, ——, 52, 95.4, 191.8, & 300.6.

In this series the distance of the Earth from the Sun is 10, and the outstanding exception is the case of Neptune.

Bode's Law of Planetary Distances.

The Basis of the Series that Earth's Distance=10.

The distance 28 in Bode's series indicates the mean semi-major axis of the belt of orbits of the 91 minor planets that lie between Mars (15.2) and Jupiter (52).

Pythagoras on 10 in relation to his Planetary System.

Was Bode's Law known to originators of the system?

Now when we remember that the advanced Planetary System of Pythagoras was claimed by him as derived from such "first principles" as "Ten is the perfect number," and that "all things are numbers," we see a possible hint that the relations of Bode's Law were not unknown to the originators of the system. Thus Dr. A. S. Pringle-Pattison states that in the Solar System of Pythagoras "The distance of the revolving orbs from the central fire was determined according to simple numerical relations, and the Pythagoreans combined their astronomical and musical discoveries in the famous doctrine of 'the harmony of the spheres.'"[1]

¶ 132. THE SOURCE OF THE PYTHAGOREAN THEORY THAT "ALL THINGS ARE NUMBERS."

Evidence of a former science of Geometrical and Numerical Classification and Co-relation of Data and Phenomena.

Egyptian attempts at its revival haphazard and foolish.

There is evidence that in early Egyptian times there was a definite conception—derived undoubtedly from the former civilisation—associated with the symbolising of phenomena and ideas on geometrical or numerical bases. In the works of the later Egyptians, however, where such symbolical intention can be traced, everything indicates that the geometrical and numerical symbolism was no longer associated with a rational basis. The symbolic art had been lost. Nothing remained but a blind faith in its existence, and haphazard and foolish attempts at its realisation in the case of the Egyptian King Lists.

The Tradition passing to Pythagoras led him to the Independent Discovery of many valuable Numerical and Geometrical Identities in Natural Law.

The Conclusion to be derived from analysis of historical progress of Greek Science.

This blind faith in a geometrical or numerical ordering of things and phenomena—though applied haphazard—ruled the geometrical, astronomical, and musical systems of Pythagoras. The boundless enthusiasm and tireless energy inseparable from faith of this nature, undoubtedly led Pythagoras to the discovery of more geometrical and numerical problems and principles than he ever received from his Egyptian tutors. It is, however, clearly certain that the bulk of his epoch-making "discoveries" and enunciations were derived from the Egyptians, and that similar advances in geometrical and astronomical thought associated with his successors were likewise derived from Egypt and Chaldæa. No other conclusion is possible when one studies an analytic tabulation of the historical progress of Greek science. An analytic statement of this character is given in Table X.

[1]Enc. Brit. (11th Edit.), Vol. XXII, p. 700a.

TABLE X.

SYNOPTICAL HISTORY OF GREEK GEOMETRY AND ASTRONOMY.

	GEOMETRY :—	*ASTRONOMY* :—
Thales (640-546 *B.C.*), *of Miletus.* About 600 B.C., visited Egypt, and studied science there. Hieronymus of Rhodes (*ap. Diog. Laer I*, 27) says, "He never had any teacher except during the time when he went to Egypt and associated with the priests." On his return from Egypt he founded the Ionian School of Astronomy and Philosophy.	Originated the equation and proportion, and was thus in a sense the originator of Algebra. Is recognised to have been the founder not only of Greek geometry, but also of Greek astronomy and philosophy. He also "founded," on a scientific basis, the geometry of the circle and of points and lines. (Proclus, *In primum Euclidis Elementorum Librum Commentarii ;* Prof. G. J. Allman, "Greek Geometry from Thales to Euclid" ; Enc. Brit., Vol. 26, pp. 720-721.)	He taught "that the sun, moon, and stars are not mere spots on the heavenly vault, but solids ; that the moon derives her light from the sun, and that this fact explains her phases ; that an eclipse of the moon happens when the earth cuts off the sun's light from her." (Prof. G. Forbes' "Hist. Astron." p. 13). He also taught the sphericity of the earth, and the obliquity of the ecliptic. (Dr. F. R. Moulton's "Celestial Mechanics," p. 30 ; Miss A. Clerke in "Enc. Brit" Vol. 2, p. 809.)
Pythagoras (569-470 *B.C.*), *of Samos.* Travelled widely in the East, visiting Chaldæa, and penetrating as far as the Ganges. About 500 B.C. he visited Egypt, and studied science there. Returning from his travels, he founded a School of Astronomy and Philosophy in Sicily. The Pythagorean doctrine of the immortality of the soul is clearly of Egyptian origin, whereas the connected Pythagorean doctrine of transmigration of the soul is certainly of a more easterly origin. The Pythagorean idea of placing natural phenomena on a numerical basis, of associating numbers with conceptions and entities, is also clearly Egyptian in its origin. Thus of the ancient Egyptians Dr. Sprenger states "An idea, a period of time, or any remarkable occurrence, were frequently connected with ideal persons in mythology, and when any similarity existed, received the same appellation." (Vyse's "Pyds. and Temp. of Gizeh," Vol. II, Append.). Hence the importance of the following from Dr. A. S. Pringle-Pattison : "Impressed by the presence of numerical relations in every department of phenomena, Pythagoras and his early followers enunciated the doctrine that 'all things are numbers.' Numbers seemed to	Originated that branch of geometry associated with his name, and dealing chiefly with areas and solids. He is credited with a knowledge of certain properties of Conic Sections, and the discovery of the law of the three squares (Euclid I, 47) is attributed to him. Diogenes Laertius states that "it was Pythagoras who carried geometry to perfection, after Moeris (Amenemhat III of the XIIth Egyptian Dynasty) had first found out the principles of the elements of that science.. ..... ; and the part of the science to which Pythagoras applied himself above all others was arithmetic." Prof. Allman states "According to Aristoxenus, the musician, Pythagoras seems to have esteemed arithmetic above everything, and to have advanced it by diverting it from the service of commerce and by likening all things to numbers. Diogenes Laertius (viii, 13) reports on the same authority that Pythagoras was the first person who introduced measures and weights among the Greeks." In the system of Pythagoras "Ten" was a sacred number and the most perfect number. He was acquainted with arithmetical, geometrical, and harmonical proportion, and concerned himself with finding	"He taught that the earth both rotates and revolves, and that the comets as well as the planets move in orbits around the sun. He is credited with being the first to maintain that the same planet, Venus, is both evening and morning star at different times." (Moulton, p. 31.) Pythagoras "learned on his travels.....to recognise the obliquity of the ecliptic, and to regard the earth as a sphere freely poised in space. The tenet of its axial movement was held by many of his followers." (Miss A. M. Clerke, Enc. Brit., Vol. 2, p. 809.) "Copernicus in the sixteenth century claimed Pythagoras as the founder of the (heliocentric) system which he, Copernicus, revived." (Forbes, p. 14.) Authorities, however, differ as to whether the system of Pythagoras was truly heliocentric. Thus Dr. A. S. Pringle-Pattison (Enc. Brit., Vol. 22, pp. 699-700) states that the Pythagoreans conceived "the earth as a globe self-supported in empty space revolving with other planets round a central luminary.... The Pythagoreans did not, however, put the sun in the centre of the system. That place was filled by the central fire."

TABLE X—(*continued*).

	GEOMETRY:—	*ASTRONOMY*:—
them, as Aristotle put it, to be the first things in the whole of nature, and they supposed the elements of numbers to be the elements of all things, and the whole heaven to be a musical scale and number. (*Meta.* A. 986a.). Numbers, in other words, were conceived at that early stage of thought not as relations or qualities predicable of things, but as themselves constituting the substance or essence of the phenomena—the rational reality to which the appearances of sense are reducible." (Enc. Brit., Vol. 22, p. 699.) Pythagoras discovered	geometrical representations of numbers. He also elaborated the conceptions of the equation and proportion as "originated" by Thales. (Authorities as above, and Enc. Brit., Vol. 22, pp. 700-703.)	The intermediate interpretation of Prof. G. Forbes seems the most likely interpretation. This is that Pythagoras "is supposed to have said that the earth, moon, five planets, and fixed stars all revolve round the sun, which itself revolves round an imaginary central fire called the Antichthon." This conception is quite modern.
	—or more probably derived from the Egyptians —the mathematical proportions of the intervals of the diatonic scale.	
Democritus (*circ.* 570-460 *B.C.*). He studied astronomy for 5 years (or 7 years ?) in Egypt (Diodor., i, 98), and claimed to have been a disciple of the Egyptian priests and the Magi, having visited also Persia and Babylon (Clem. Str., i, p. 304). He knew of the obliquity of the ecliptic.		*Anaxagoras* (*born* 499 *B C*) studied astronomy in Egypt. "He held that in a solar eclipse the moon hides the sun, and in a lunar eclipse the moon enters the earth's shadow." (Forbes, p. 14).
Eudoxus (408-355 *B.C.*) *of Cnidus.* Visited Egypt with Plato.	His geometrical work comprised the establishing of expressions for the volumes of the pyramid, prism, cone, and cylinder.	In astronomy, he first suggested arbitrarily representing the apparent motions of the sun, moon, and planets as taking place upon revolving spheres; the motion of each planet being resolved into its components, each component being given a separate revolving sphere. The hypothesis was not stated as an actual belief, but rather as a mathematical conception—failing any then more satisfactory conception—to permit of the formulating of rules and methods for making astronomical calculations. This system—the Eudoxian or "homocentric"—was elaborated by Callipus and Aristotle in the middle of the 4th century B.C. (about 350-330 B.C.)
Plato (429-350 *B.C.*), *the Athenian philosopher.* Visited Egypt and Cyrene. In Egypt he conversed with the Egyptian priests. He was the pupil of Socrates, and was a follower of Pythagoras.	Plato touched upon astronomical and geometrical questions, only when these came within the scope of his system of philosophy. In no strict sense can he be termed a mathematician nor yet an astronomer. He, however, "proposed to astronomers *the problem of representing the courses of the planets by circular and uniform motions.*" (Forbes, p. 17.)	

TABLE X—(*continued*).

	GEOMETRY:—	*ASTRONOMY*:—
Euclid lived during the reign of Ptolemy I, king of Egypt (323-285 *B.C.*) He is said to have founded the school of mathematics at Alexandria.	Euclid's great geometrical work is "The Elements," contained in thirteen books, in which is laid down the fundamental basis of that branch of modern mathematics known as Euclidian geometry.	One work, Euclid's *Phaenomena*, is of an astronomical nature and deals with problems concerning the apparent motion of the celestial sphere.

It is generally admitted that few of the propositions, theorems, etc., in Euclid's *Elements* are original. Euclid merely compiled and arranged the hitherto unsystematized geometrical work of his predecessors. He placed the geometry of the line and the circle on a soundly logical basis and in a sequence that has had more influence upon modern method than authorities have taken the pains to note or admit.

Aristyllus and Timocharis (*circ.* 320-260 *B.C.*) of the school of Alexandria.		They observed at Alexandria, and constructed the first star-catalogue.
Aristarchus (320-250 *B.C.*) ***of Samos.*** Studied astronomy at Alexandria.	He wrote a work on "Magnitudes and Distances" describing a *theoretically* sound method of determining the relative distances of the sun and moon. He correctly determined the sun's diameter at half a degree, and according to Archimedes had formulated a heliocentric planetary system in advance of the more complicated heliocentric system of the Pythagoreans.	
Archimedes (*circ.* 287-212 *B.C.*) ***of Syracuse in Sicily.*** Studied mathematics at Alexandria.	His geometrical works comprise treatises on the sphere and cylinder, on the measurement of the circle (showing that the value of π is between $3\frac{1}{7}$ and $3\frac{10}{71}$), on conoids and spheroids, on spirals, etc.	A work of an astronomical nature was his now lost work *On Sphere-making*. Professor F. R. Moulton under the heading of "Dynamical Astronomy," states that "Archimedes is the author of the first sound ideas regarding mechanical laws. He stated correctly the principles of the lever and the meaning of the centre of gravity of a body.....It is a remarkable fact that no single important advance was made in the discovery of mechanical laws for nearly 2000 years after Archimedes, or until the time of Stevinus (1548-1620), who was the first, in 1586, to investigate the mechanics of the inclined plane, and of Galileo (1564-1642), who made the first important advance in Kinetics."
Eratosthenes (276-196 *B.C.*) A Greek astronomer in charge of the library at Alexandria in the reign of Ptolemy III, Euergetes.	He determined (approximately correct) the value of the obliquity of the Ecliptic, and the circumference of the earth. His version of the Egyptian Dynastic Chronology contains periods derived from Genesis, from the true period of the Precession of the Equinoxes, and from the Pyramid base measure in common Egyptian cubits. (Refer Plate XVI and ¶¶ 94 and 102.)	

TABLE X—(*continued*).

	GEOMETRY :—	*ASTRONOMY* :—
Apollonius of Perga Lived during the reigns of Ptolemy III Euergetes, and Ptolemy IV Philopater (B.C. 247-205). He studied mathematics at Alexandria.	Apollonius wrote the famous treatise on conic sections that earned for him the title, "the great geometer."	In astronomy Apollonius originated the working hypothesis of epicycles, which hypothesis formed the basis for all astronomical conceptions and observations from Ptolemy to Copernicus. The hypothesis of epicycles originated from the "homocentric" system of Eudoxus, but was a considerable advance on the latter, from point of view of application to practical problems.
Hipparchus (190-120 *B.C.*) Born at Nicæa in Bithynia. He settled at Rhodes and possibly later at Alexandria.	He founded the science of trigonometry, plane and spherical, and compiled the first table of chords.	He is said to have founded the science of observational astronomy. More accurately, we may say that he was the first of a long series of practical astronomers whose observations were placed on record.

He is similarly stated to have invented the planisphere, which, however, he borrowed from the Chaldæans. Astronomical historians are now generally agreed that Hipparchus owed much of his observational data to the long series of observations that had been carried out by the Chaldæans for many centuries, if not for close on 2000 years, before his time. Thus Prof. Forbes states (p. 18) that "making use of Chaldæan eclipses, he was able to get an accurate value of the moon's mean motion." This is in fact stated by Ptolemy in his *Almagest*. (Refer Prof. Simon Newcomb's use of the data of Hipparchus and Ptolemy, in his "Researches on the motion of the Moon," published by U.S.A. Govt. Printing Office, 1878.)

Probably much of the Chaldæan data of Hipparchus was derived from the works of the Chaldæan priest of Bel, Berosus or Berossus (the Greek form of his name), who "appears to have compiled his works in the reign of Antiochos II, B.C. 261-46." (Brown's "Prim. Constell." Vol. II, p. 331.) As Mr. Brown states, "he (Berosus) also compiled various astronomical treatises, which have unfortunately been lost; they furnished material for Greek writers such as Diodorôs, and the most important of them was a translation of what Prof. Sayce calls 'the standard astrological work of the Babylonians and Assyrians.' ..... Opinions of Bêrôsos respecting the moon have been preserved by Plutarch, Stobaios, and Vitruvius, and the latter (*De Architect*, IX, iv, 7) states that he treated of the properties of the signs of the Zodiac, of the planets, and of the sun and moon; and that he established a school of learning in the island of Kôs." Kos or Cos, the modern Turkish Island of Stanko, is at the mouth of the Gulf of Halicarnassus (Asia Minor), and about 50 miles North-West of the Island of Rhodes where Hipparchus had settled.

Centuries before Hipparchus, the Chaldæans, Egyptians, and Chinese knew of the "Precession of the Equinoxes." It is, however, claimed for Hipparchus that he discovered the "Precession" quite independently of the ancients from a comparison of his own observations and those of Timocharis at Alexandria. Syncellus in his "Chronographia" states that the "fabled period" of the Precession, amongst the Egyptians and Greeks, was a period of 25 Sothic Cycles of 1461 "years," or altogether 36,525 years. This gives a rate of $35\frac{1}{2}''$ of angle per year, and the rate determined by Hipparchus was estimated by him as not less than $36''$. As to whether the rate of Hipparchus was influenced by the rate of the "fabled period" noted by Syncellus, or that of Syncellus derived from Hipparchus it is for our further discussion to show.

Hipparchus was the first to observe and appreciate the elements of the orbit of the earth, (or rather the apparent orbit of the sun), and the orbit of the moon, and by many bold conceptions based on his own vast experience of celestial observation—conceptions that were vastly in advance of his times—he anticipated in many features the basal requirements of the modern astronomical Ephemeris. He compiled the first solar tables, and also compiled a catalogue of 1080 stars on a constellational basis borrowed from the Chaldæans. His realization of the eccentricities of the orbits was a further great advance in geometrical astronomy. He, however, believed that all bodies revolved round the earth as centre.

TABLE X—(*continued*).

Menelaus of Alexandria flourished towards the end of the 1st century B.C. His mathematical work considerably advanced the science of Spherical Trigonometry and Astronomy.

Ptolemy (*fl. circ.* 120-160 A.D.) was a native Egyptian, famous not only for his classical treatment of mathematical, astronomical, and geographical problems, but also for his having preserved in his great astronomical work, the *Almagest*, astronomical and chronological data—containing observations and records of Hipparchus and the Chaldæans—that has enabled history to be placed on a scientifically accurate basis.

Ptolemy may be said to have done for the spherical geometry and trigonometry of Hipparchus and Menelaus what Euclid did for the work of the earlier geometers. He also combined and systematized the "eccentric" hypothesis of Hipparchus, and the "epicyclic" hypothesis of Apollonius of Perga.

¶ 133. THE QUANTITATIVE AND QUALITATIVE RELATIONS OF EGYPTIAN AND GREEK KNOWLEDGE.

Successive Greek Philosophers visited Egypt for reason that their predecessors had merely touched the fringes of Egyptian Knowledge.

One obvious conclusion is to be derived from the analytic statement of Table X. This is, that if what Pythagoras learnt in Egypt enabled him to construct a system of geometry and astronomy excelling that of his teachers, there was clearly no necessity for his successors to visit Egypt for further knowledge of geometry and astronomy.

It is also obvious that the Egyptian priests would scarcely permit the Greeks to learn as much geometry and astronomy as they themselves knew, and that the Greeks—quick to discern scientific knowledge in the meagre information meted out to them—would have been equally quick to discern when no further knowledge was available. From this it would seem to follow that most, if not all, of the knowledge independently discovered by the Greeks was previously known to the Egyptians. For although the Greeks made great advances in geometry and astronomy, the fact remains that they still continued to seek improvement in Egypt. This is the fact that gives some measure of the amount of geometrical and astronomical knowledge that the Egyptian Priests possessed —knowledge of these subjects as distinct from understanding concerning their origination and the derivation of their first principles.

From first to last, the Greeks obtained but an insignificant fraction of the knowledge the Egyptian Priests possessed.

¶ 134. GREEK MEASURES AND SCIENCE CONTEMPORANEOUSLY FROM EGYPT.

Greek Geometry and Greek Measures from Egypt suggest contemporaneous derivation.

Of this knowledge we have already had evidence in our consideration of the origin of the Egyptian systems of measures. The connection between geometry and measures naturally suggests that the Greeks derived both from Egypt about the same time. Thus, as noted by Herodotus in the 5th century B.C.,

Cubit of Samos and its Geometrical relations suggest grounds for inquiry as to application of cubit.

the inhabitants of Samos were already using the Egyptian common cubit of 20.63 B″. It is the existence of this cubit, and the obvious manner of its derivation, that led to the discovery of the relatively high geometrical and mathematical skill attained by the former civilisation from which the oral traditions of the ancient Egyptians had descended.

That Pythagoras came from Samos suggests origin of his interest in Geometry.

The use of this cubit in Samos would naturally lead to the Samians making further inquiry concerning its application to the measurement of areas. Not improbably it was this desire that led Pythagoras—whose earlier years are identified with Samos—to interest himself in the measurement of areas. Now

Credited with Introduction of Weights and Measures amongst Hellenes after his visit to Egypt.

it is stated by Aristoxenos, the musician, that Pythagoras "was the first person who introduced weights and measures amongst the Hellenes" (Diog. Laert. *Pythagoras*, xiii), and Professor G. J. Allman[1] states that "on examining the purely geometrical work of Pythagoras and his disciples.....we observe that it is much concerned with the geometry of areas, and we are indeed struck with its Egyptian character."

The Pythagorean Systems of Astronomy, Measures and Numbers derived from an Original System in use by the Lost Civilisation of "Prehistoric" Times.

It is certain, therefore, that the basal geometry of the Pythagorean system was that of the Egyptians. This Egyptian system was based upon the conception of the year circle and its square of equal area—from which the Samian or common Egyptian cubit was derived—and was derived originally from the scientific system of the civilisation that had preceded the period of the early Egyptian, Babylonian, and Mediterranean civilisations. It is to this former lost civilisation that we must refer the origination of the heliocentric planetary system of Pythagoras.

[1]Enc. Brit. (11th Edit.), Vol. XXII, p. 701c.

Section III.—Description of Plates.

¶ 135. PLATE XIII. EQUAL AREAS.

A rectangle constructed of length equal to the circumference of any given circle and of breadth equal to the diameter of the given circle is in area equal to four times the area of the given circle.

Area of any 4 equal circles= diameter (D) × circumference (C).

Thus, let C = Circumference of Given Circle,
and D = Diameter of Given Circle.

$$\pi = \frac{C}{D} = 3.14159+.$$

Defines a rectangle of area equal to area of 4 circles.

Then $C = \pi D$, Therefore $D = \frac{C}{\pi}$

Side of square of area equal to area of 4 circles. $=\sqrt{D \times C}$

Area of Circle $= \frac{\pi D^2}{4}$

4 times Area of Circle $= \pi D^2 = \pi D \times D = \pi D \times \frac{C}{\pi} = D \times C.$

Area of Rectangle of area 4 times area of circle $= D \times C.$
Also, square of area 4 times area of circle $= D \times C.$
Side of Square $= \sqrt{D \times C}.$

Basis of Primitive Scientific Metrological System :—

The ancients formulated their metrological systems upon the above relations and the year circle of 3652.42 Primitive inches in circumference—a representation of the solar year to the scale of 10 P inches to the day. This gave a circle of 1162.6 diameter. Four of such circles are represented as A, B, C, and D on Plate XIII. EFGH is the corresponding rectangle of equal area. Its length FH = EG = 3652.42 P″., and its breadth EF = GH = 1162.6 P.″. KLMN is the corresponding square of equal area. Area KLMN = (3652.42 × 1162.6) square P. inches. Side of square = KL = LN = $\sqrt{3652.42 \times 1162.6}$ = 2060.66 P.″. The three equal areas—4 circles, rectangle, and square—were defined as the *aroura*, the great unit of square measure.

3652.4 P. inches circumference × 1162.6 P. inches diameter defines rectangle of equal area.

The "Aroura."

Each of the circles A, B, C, and D falls precisely internal to the outer circle of stones at Stonehenge.

Stonehenge Circle=¼ "Aroura" Circle

Derivation of three systems for common use.

The circumference of 3652.42 P″ was divided into 200 circumferential cubits of 18.2621 P″. The diameter of 1162.6 P″ was divided into 100 diametric feet of 11.626 P″. The side of the square of equal area (the *aroura*) was divided into 100 common cubits of 20.6066 P″. This supplied three systems of linear units—a system of circumferential units, a system of diametric units, and a system for the linear measurement of straight line plane figures. Each system has its own cubits, feet, and digits.

Separate Cubits, Feet, and Digits for circumferences, diameters, and linear measurement of straight line plane figures

The three systems were therefore derived from a system of Primitive Inches. The Primitive inch was of the value of 1.0011 British inches. Accidentally or intentionally, this is a 500 millionth part of the Earth's Polar Diameter.

The original or Basal system, a system of Earth's Polar diameter inches.

The derived systems were originally invented for *common use* for the purpose of avoiding calculations involving π. Simple formulæ connected the three systems. The result of one such simple calculation is shown in the lower portion of Plate XIII. Here the $\frac{1}{100}$th strip of the *aroura* square is equal to the area of the segment of the circle of radius 50 diametric feet and of arc length 12 circumferential feet. Typical formulæ for the calculations are given in ¶ 137C.

Simple formulæ avoiding π.

Typical example of calculated equal areas.

The original or basal system and the three derived systems are illustrated to comparative scale on Plate XV (refer ¶¶ 137, 137a, b and c for description, formulæ, and worked examples).

¶ 136. PLATE XIV. GEOMETRICAL ANALOGY.

Simple relationship between Quadrants and their Isosceles Triangles of equal area and equal definitive linear measures

As a corollary of the relationship of ¶ 135, the area of a quadrant of a given circle = Length of Quadrant arc × ½ radius. This defines the area of a triangle of area equal to the quadrant area. The perpendicular height of the triangle = the quadrant radius and the base of the triangle = the length of the quadrant arc.

Plate XIV shows the relationship for the case of two similar isosceles triangles mOn and $m_1O_1n_1$, and two quadrants MON and $M_1O_1N_1$.

Larger Figures.	Smaller Figures.
Triangle height h = Quadrant radius h.	Triangle height h_1 = Quadrant radius h_1
Triangle base mn = Quadrant arc MN.	Triangle base m_1n_1 = Quadrant arc M_1N_1.
Triangle area mOn = Quadrant area ONQMO	Triangle area $m_1O_1n_1$ = Quadrant area $O_1N_1Q_1M_1O_1$

The base angle of both triangles is the base angle of the Great Pyramid's right vertical section, 51°-51′-14″.3.

The underlying conception of circular arc developments.

The importance of the Mid-tangent in the conception.

The conception underlying this representation in the Pyramid is that the Isosceles triangle of area equal to the quadrant area is constructed from the development of the quadrant arc on its mid-tangent. Thus on left hand side of middle Plate XIV, Q is the middlepoint of the quadrant arc MQN and mQn is the tangent at mid-point Q. The quadrant arc MQN is developed on to the tangent mQn, so that when QM is straightened out along Qm, M gives the point m, and when QN is straightened out along Qn, N gives the point n. The process is illustrated on the bottom left hand figure. Hence QM = Qm, QN = Qn, and MQN = mQn. Joining Om and On, we find that although the area has been distorted and the definitive linear dimensions retained,—OQ common to both, and MQN = mQn—the area of the isosceles triangle mOn is nevertheless equal to the area of the quadrant OMQNO. When one comes to think of it, this is a very remarkable and simple property. It is, however, a property that is seldom conceived in tangible form by the mathematician.

Similar sectors developed give similar triangles.

Areas in comparative series equal.

The same conception and simple relationship extend to sectors and triangles. Similar sectors, when developed, give similar triangles, each of area equal to the area of its sector, and of definitive dimensions equal to the definitive dimensions of its sector.

¶ 137. PLATE XV. COMPARISON OF ANCIENT SCALES OF MEASUREMENT.

Derivation from Year Circle Geometry and Primitive Inch.

The systems of measures briefly described in ¶ 135 are illustrated to comparative (reduced) scale on Plate XV. ¶ 135 described how the circumferential cubit, the diametric foot, and the common cubit were derived from the original linear unit, the Primitive Inch. Direct diagrammatic illustration is given in the lower portion of Plate XV. This gives a representation (right hand figure) of an Egyptian cubit rod noted by Professor Petrie.[1] Its length is the circumferential cubit, and on it is marked off the length of the diametric half-foot. The right hand figure illustrates the manner of direct derivation from the vear circle geometry and the original Primitive inch.

THE DIAMETRIC SCALE:—

The Diametric Scale.

With the derived diametric foot (11.626 P″) as basis, this was divided off into 16 digits—each of value 0.7266 P″. The number of digits is from Petrie.[1]

Its primary unit the diametric foot of 11.626 primitive inches.

Whereas one and a half diametric feet contained 24 diametric digits, the diametric cubit was reckoned to contain 25 diametric digits. This is the real origin of "the well-known ratio of 25 : 24," noted by Petrie.[1] (Refer ¶¶ 88-90.)

[1]Enc. Brit. (11th Edit.), Vol. xxviii, p. 483 c.

THE CIRCUMFERENTIAL SCALE :—

The Circumferential Scale.

With the derived circumferential cubit (18.2621 P″) as basis, this was divided off, like the diametric cubit, into 25 digits—each of value 0.7305 P″. The number of digits is from Petrie.[1] The circumferential cubit also contained one and a half circumferential feet.[1] Petrie here remarks that this foot "although very well known in literature, is but rarely found.....The Greek system, however, adopted this foot as a basis for decimal multiplication." (Refer ¶¶ 88 and 89).

Its primary unit the circumferential cubit of 18.2621 primitive inches.

THE LINEAR SCALE FOR SIDES OF RECTILINEAR AREAS :—

Linear Scale for Square Measures.

With the derived cubit (20.6066 P″) as basis, this was divided off into 32 digits—each of value 0.644 P″. The number of digits in the early Babylonian and Egyptian examples of this cubit is from Petrie.[2] Petrie explains that the later division into 28 digits was due to a confusion of this system with the systems herein defined as diametric and circumferential. Thus, 28 circumferential digits = 20.454 P″, closely approximating to the true value of 20.6066 P″ for the common cubit.

Its primary unit the common cubit of 20.6066 primitive inches.

¶ 137a. THE ALGEBRAIC RELATIONSHIP OF UNITS. (PLATE XV.)

For any given circle,

Let Diameter = D diametric cubits = d diametric feet = δ diametric digits.
Circumference = B circumferential cubits
= b circumferential feet
= β circumferential digits.
Side of Square of equal area
= L common cubits
= λ digits of common cubit.
Area of Circle = { L^2 square cubits (common) / or H square cubits (common) }
= { λ^2 sq. digits / or h sq. digits } = A *arourae.*

Algebraic Symbols.

Formulæ of relationship between units of same scale.

Then $\delta = 16d = 25D$ .. .. (1)

$\beta = \frac{50b}{3} = 25B$ .. .. (2)

$\lambda = 32L$ .. .. (3)

And $b = 3d$, $B = 2d$ .. .. (I)

$L = \frac{d}{2}$, $\lambda = 16d$ .. .. (II)

Formulæ of relationship between units of different scales.

$H = \frac{d^2}{4}$, $h = (16d)^2$ .. .. (III)

$A = \frac{d^2}{40,000}$ .. .. (IV)

Method of using formulæ.

If any one value—A B b, d, H, h, L, or λ—be given, all the other values can be found directly from the formulæ I to IV.

If any one of the values D, δ, or β is then required, it can be derived from formulæ (1) and (2).

[1]Enc. Brit. (11th Edit.), Vol. xxviii, p. 483 b.
[2]Ibid. p. 482 d.

If any one of the values D, δ, or β is given, its value in terms of d—for D and δ—and in terms of b or B for β, can be found from formulæ (1) and (2), and thereafter substituted in formulæ I to IV, as

$$d = \frac{25D}{16}; \quad d = \frac{\delta}{16}; \quad \text{or } b = \frac{3\beta}{50}; \quad B = \frac{\beta}{25}.$$

¶ 137b. EXAMPLES OF SIMPLE RELATIONS. (PLATE XV).

An important simple relation between diameter and side of square of equal area.

One important relation is obtained from the formulæ as follows :—

A given diameter = δ diametric digits.

From Formula (II) :—

Length of side of square of equal area, in digits of common cubit = $\lambda = 16d$.

From (1) :— $\delta = 16d$.

Hence $\lambda = \delta$.

Otherwise expressed, the length of side of the square of area equal to the area of a given circle contains the same number of digits of the common cubit as the diameter of the given circle contains diametric digits.

Example for a given diameter :—

A worked example of the above is given for a circle of diameter measuring 2,000 diametric digits.

FOR DIAMETER :—

Various statements for diameter in different units.

From (1) :— $\delta = 2{,}000$ diametric digits.

$$d = \frac{\delta}{16} \text{ diametric feet} = \frac{2{,}000}{16}$$
$$= 125 \text{ diametric feet.}$$
$$D = \frac{\delta}{25} \text{ diametric cubits} = \frac{2{,}000}{25}$$
$$= 80 \text{ diametric cubits.}$$

FOR CIRCUMFERENCE :—

From (1), (2) and (I) :—

Various statements for circumference in different units.

$$\beta = \frac{25\delta}{8} \text{ circumferential digits} = \frac{25 \times 2{,}000}{8}$$
$$= 6{,}250 \text{ circumferential digits.}$$
$$b = \frac{3\delta}{16} \text{ circumferential feet} = \frac{3 \times 2{,}000}{16}$$
$$= 375 \text{ circumferential feet.}$$
$$B = \frac{\delta}{8} \text{ circumferential cubits} = \frac{2{,}000}{8}$$
$$= 250 \text{ circumferential cubits.}$$

FOR SIDE OF SQUARE OF EQUAL AREA :—

Various statements (linear and square) for square of equal area in different units.

$$\lambda = \delta = 2{,}000 \text{ digits of common cubit.}$$
$$L = \frac{\lambda}{32} = 62\tfrac{1}{2} \text{ common cubits.}$$

AREA OF SQUARE OF EQUAL AREA :—

$$\lambda^2 = 2{,}000 \times 2{,}000 = 4 \text{ million sq. digits of common cubit.}$$
$$L^2 = \left(\frac{\lambda}{32}\right) = 3906.25 \text{ sq. (common) cubits.}$$
$$A = \frac{d^2}{40{,}000} = \frac{125 \times 125}{40{,}000} = 0.390625 \textit{ aroura.}$$

¶ 137c. THE SIMPLE CALCULATIONS FOR AREAS OF SECTORS AND SEGMENTS OF CIRCLES.

Let m = No. of Circumferential Cubits in a given Sector arc, of diameter d diametric feet, for circle of B circumferential cubits.

Area of whole circle $= \frac{d^2}{4}$ common square cubits. (From ¶ 137a, Formula III).

Number of the given sectors in circle $= \frac{B}{m} = \frac{2d.}{m}$ (¶ 137a, Formula I).

Therefore, Area of given Sector $= \frac{d^2}{4} \times \frac{m}{2d} = \frac{md}{8}$ common square cubits.

Area of sector in common square cubits= ⅛-sector arc in circumferential cubits × Radius in diametric feet.

Otherwise expressed, the area of a given sector in common square cubits is equal to one-eighth the product of the number of circumferential cubits in the sector arc and the number of diametric feet in the diameter of the circle; or, is equal to a quarter of the product of the number of circumferential cubits in the sector arc and the number of diametric feet in the radius of the circle.

The area of segment= area of sector—area of sector triangle.

To obtain the area of the segment in the given sector, in common square cubits, deduct the area of the isosceles triangle of the given sector from the area of the sector as above obtained in common square cubits.

¶ 138. PLATE XVI. CHART SHOWING THE GEOMETRICAL, ASTRONOMICAL, AND NUMERICAL BASES OF THE FICTITIOUS CHRONOLOGIES OF THE ANCIENT EGYPTIAN KING LISTS.

General remarks :—

Facts Long Known.

Co-ordination New.

The chart is a record of facts that have been long in existence—in some cases for several thousand years. The elements that are distinctly new are the co-ordination of these facts and the self-evident origin and significance of the facts revealed by this co-ordination.

New facts from Co-ordination.

The outstanding new facts derived from the statement of the chart are the following :—

Chronology of Egyptian King Lists fictitious.

(1) That the Egyptian King Lists of the Egyptian Priest, Manetho, do not contain a true statement of ancient Egyptian Chronology. (¶¶ 92, 118 and 119.)

Modern Egyptological theory of chronology unknown.

(2) That prior to the 3rd century B.C., the Egyptians knew nothing concerning the hypothesis now adopted as the basis of modern Egyptological chronology. (¶ 98 and Appendix.)

A written record of the measurements and units of a Standard Pyramid.

(3) That the King Lists contain a written record of the numerical values of all the external linear and angular measurements of a Standard Pyramid (¶¶ 93, 95–99, 118 and 119), in terms of units specified in the Lists as of values equal to 1.0011 British inches and 20.63 British inches respectively. (¶ 94.)

The Standard Pyramid is the Great Pyramid.

(4) That the Standard Pyramid of the Egyptian King Lists is the Great Pyramid of Gizeh. (¶¶ 94, 99–101 and 118.)

The complete statement of Manetho's Divine Dynasties is as given in Table A of chart. This is precisely as stated by Sir Ernest Budge, " Book of Kings," Vol. I, pp. lx and lxi.

The detailed statement of Manetho's Human Dynasties is as given in the Appendix. This is precisely as stated in Baron Bunsen's Greek and Latin Text (" Egypt's Place," Vol. I, Appendix), for the versions of Africanus and Eusebius, and in Cory's " Fragments " (Hodge's Edition, 1876). The other lists are preserved in the same works. Statements of Manetho's Lists also appear in Budge's " Book of Kings," Vol.I, his " History of Egypt," Vol. I, in Sayce's " Ancient Empires of the East " (Appendix), and in the various volumes of Petrie's " History of Egypt." These, however, generally omit some important details and statements peculiar to the Version of Africanus. Budge's statement ("Book of Kings," Vol. I) of the basal totals of years for the Version of Eusebius for Manetho's Book I, II and III has been adopted in the chart (Table B). The stated totals for the same books, according to the Version of Africanus, have been adopted from Cory in the chart (Table B).

Authorities for statement of Egyptian King Lists.

¶ 138a. SOME DETAILS CONCERNING THE VERSION OF AFRICANUS.

Four features affecting the statement of the Version of Africanus in Tables B and C call for special remark.

Pepy II Died 100 Years Old after Reigning 95 Years.

Stated duration Dynasty VI (Africanus) 203 years.

Added Duration 198 Years.

(1) Under Dynasty VI, it is stated that the fourth king, "Phiŏps, who began to reign at six years of age, reigned till he had completed his 100 year." The stated total for the duration of the dynasty—given as 203 years—includes reign of Phiŏps (Pepy II) as of duration of 100 years. Accordingly "203 years" appears in the summations giving one series of fictitious totals for Book I. But the reign of Pepy II was 94 or 95 years, and the total of the Dynasty therefore 197 or 198. Petrie (Hist. Egypt, Vol. I, Dyn. VI) adopts 95 and 198 years respectively. This agrees with the summations giving another series of fictitious totals for Book I, whereas 94 and 197 years fail to give summations agreeing with any fictitious system.

Dynasty XVIII. Amosis I.

Statement of duration of reign, 25 years, omitted, but included in added summations of some systems.

(2) Under Dynasty XVIII the name of the first king appears as Amosis (Amosis I), with duration of reign omitted. Other versions give this reign as 25 years. Accordingly one series of fictitious totals for Book I, Version Africanus, omits the reign of 25 years, and another series includes the reign as 25 years; both series supplying the numerical bases of their respective systems of fictitious construction.

The 1050 Years of Africanus, Book III.

Interregnum between Dynasties XIX and XX.

Harris Papyrus.

Duration, 182 Years (Africanus).

178 Years (Old Chronicle)

(3) In Book III the stated total duration of time after Dynasty XIX and up to end of Dynasty XXXI is given as 1,050 years, whereas the added stated totals for Dynasties XX to XXXI inclusive amount to 868 years. This indicated the theory of an interregnum of 182 years between Dynasty XIX and Dynasty XX. Such an interregnum is mentioned in the Harris Papyrus. This was written in the early period of Dynasty XX, under king Ramessu III, who was closely associated with the events that terminated the Interregnum. It would seem that there are good grounds for adopting this theory of the Version of Africanus.

Again, the Old Chronicle gives the statement of 2,324 years for the duration of all human Dynasties. Its stated totals for duration of Dynasties, however, amount to 1,881 years. This gives an unplaced interregnum of 178 years—4 years short of the total of Africanus for the Interregnum between Dynasty XIX and Dynasty XX. As the Old Chronicle totals for Dynasties XX to XXX inclusive amount to 868 years—as in Dynasties of Book III, Africanus—it would appear that the two periods are identical.

The 990 years interpolated in Version Africanus.

(4) At the end of Dynasty XXIV in the Version of Africanus, there occurs the statement "Total 990 years."

The query concerning 31 years.

Now in the statement of the previous dynasty there occurs a note that throws some light upon this. The note is *Ζὴτ ἔτη λά*, read as "Zet 31 years." For long Zet was supposed to be an unknown king's name. It appears in no other version of any List. Professor Petrie and Mr. F. W. Read have shown, however, that *ζητ* was commonly entered in such MSS. as Manetho's by editors, critics and scholiasts to indicate a query.[1] Petrie explains that Manetho here added a query concerning 31 years that belonged to a system of summation, but could not be accounted for by the summation of details. The added totals of Africanus, including the 31 years noted, by agreeing with the system framing the summations, confirm Petrie's explanation.

Custom of entering such queries in MSS.

The Entry of 990 Years. A query concerning this as referring to a period to complete a requisite total.

The summation of Plate XVI, Table A indicates that the statement of Africanus concerning the 990 years is to be similarly explained. 990 years added to 24,837 years, the duration of the Divine Dynasties, give 25,827 years, the sum of the Pyramid's base diagonals. 990 years added to the 4,611 years of Eusebius for the human kings, give the 5,601 years of Africanus for the human kings.

[1] *Ancient Egypt*, 1914, p. 32. 1916, p. 150.

¶ 139. PLATE XVII. DIAGRAMMATIC REPRESENTATION OF PROFESSOR PETRIE'S RECONSTRUCTION, AND OF THE NEW RECONSTRUCTION OF THE GREAT PYRAMID FROM PETRIE'S SURVEY.

This Plate fully explains itself. One item, however, may require amplification; the relation between the dimensions on diagrams of Plate XVII, stated in Primitive or Pyramid inches, and the dimensions according to Petrie's survey in British inches.

Size of side of base square of core masonry plane surfaces, 8,991 P′.

Petrie's survey for the mean square side defining the corners of the existing core surface base gave a length of 9001.5 B″ ± 1.0 B″. Reduced to Pyramid inches (on basis of ¶¶ 81, 94 and 101), this is 8991.6 P″, ± 1.0 P″ or, as stated in round numbers of inches as on Plate XVII, Figs. A, B and C, 8,991 P″.

Distance between opposite centres of core masonry base sides, 8,919 P′

Petrie's mean distance between the centres of two opposite sides of the core masonry base—*i.e.*, as along line of AB, Figs. A, B and C; or on Section AB, Figs. a, b and c—gave 8,929 B″, or in round numbers of P. inches, as on all figs. of Plate XVII, 8,919 P″.

The other relations defining the casing base square, and its central hollowing in, are as given in ¶¶ 99–101.

As to what Petrie means by a core plane face, the reader is referred to Plate XVIII and ¶ 140.

The unfortunate effect of an incorrect restoration of the Great Pyramid.

It is unfortunate that Professor Petrie, in observing the core masonry hollowing, did not extend the same feature to the restoration of the casing. By reason of this unfortunate omission, scientists for 42 years have been led to believe that the theory of the late Astronomer Royal for Scotland—Professor Piazzi Smyth—requiring a Great Pyramid base circuit of 36,524 Pyramid inches, was nothing more than a delusion. It is equally unfortunate that Professor Smyth saddled his theory with corollaries and side issues rightly deemed by his scientific contemporaries to be fallacious.

¶ 140. PLATE XVIII. DIAGRAMMATIC PERSPECTIVE VIEW, ILLUSTRATING FEATURES OF GREAT PYRAMID'S CORE MASONRY.

As explained on the Plate, the hollowing-in of the core face escarpments, and the depths of courses are considerably exaggerated. In consequence of the latter, the number of courses is reduced. The thicker 5th course, however, gives a general idea of the appearance of the 35th course. The view illustrates the Pyramid's appearance prior to the addition of the casing.

Petrie's Core Plane Faces. And Core Plane Base.

What Petrie means by a core plane face is defined by the plane geometrical surfaces cCBb and bBAa. Petrie's core plane base is the actual square defined by the corner points C, B, A and D (the last unseen). This base square was obtained by sighting down from c, b, a and d, along the line of the stepped (arris) edges, cC, bB, aA and dD (the last unseen). The core base square is defined by the straight lines CB, BA, AD (unseen) and DC (unseen).

Definition of Pyramid's Hollowed-in effect.

The hollowed-in effect is defined on the base by the lines CHGB and BFEA. HG and FE are each about 36 inches horizontally internal to the square base sides CB and BA. HG and FE were obtained by sighting down the stepped core courses from c to H and b to G; and from b to F and a to E.

How Petrie determined the Core Plane Base.

Petrie states, "The form of the present rough core masonry of the Pyramid is capable of being very closely estimated. By looking across a face of the Pyramid, either up an edge, across the middle of the face, or even along near the base, the mean optical plane, which could touch the most prominent points of all the stones, may be found with an average

variation at different times of only 1.0 inch. I therefore carefully fixed, by nine observations at each corner of each face, where the mean plane of each face would fall on the socket floors; using a straight rod as a guide to the eye in estimating. On reducing these observations to give the mean form of the core planes at the pavement level, it came out thus :—

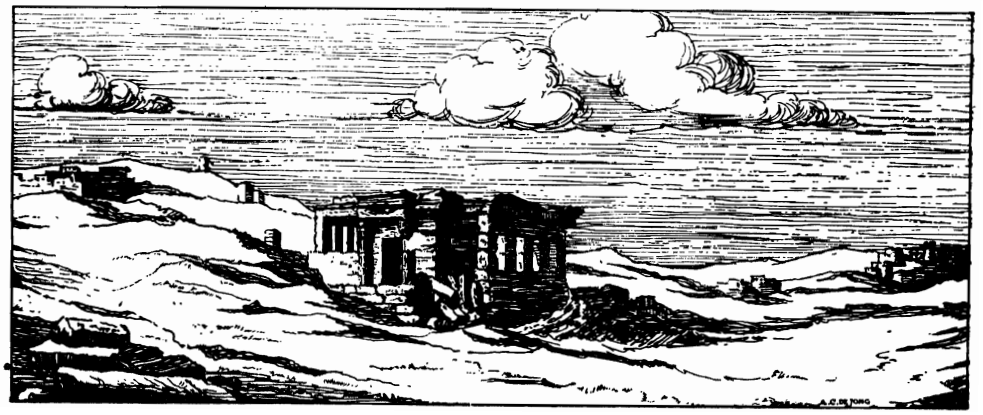
Petrie's measurements for same.

	Core Plane Sides. B″.
N.	9002.3
E.	8999.4
S.	9001.7
W.	9002.5
Mean	9001.5
Mean difference..	1.0."[1] (Refer ¶ 139.)

How Petrie determined the Hollowing-in feature.

On pp. 43–44, Petrie then states as to "the faces of the core masonry being very distinctly hollowed." "This hollowing," he continues, "is a striking feature; and beside the general curve of the face, each side has a sort of groove specially down the middle of the face..... The whole of the hollowing was estimated at 37 B″ on the N face....."

[1]Pyds. and Temples of Gizeh, pp. 37, 38.



CHAPTER III.

THE ELEMENTS OF ANCIENT GRAVITATIONAL ASTRONOMY.

SECTION I.—THE PYRAMID'S EXTERNAL DEFINITION OF THE EARTH AND ITS ORBIT.

¶ 141. THE ANALYTICAL APPLICATION OF PETRIE'S PYRAMID SURVEY DATA.

Accuracy of Petrie's survey data.

Professor Petrie's admirable survey data for the Great Pyramid are so comprehensive and accurate as to enable us to settle three momentous questions. These questions, which are closely inter-related, may be expressed as follows :—

Basis for determining designer's intentions,

(1) How far the existing measurements give evidence concerning the designer's intentions,

Workmen's errors.

(2) How far they indicate the extent of workmen's errors, and

Movements due to subsidence and earthquake.

(3) How far they indicate the extent of internal and external movements due to subsidence and earthquake shock.

Conversion of data to Pyramid azimuth for analytical purposes.

To form the necessary basis for the analytical investigation for the above, Petrie's system of Survey Co-ordinates has had to be converted into an equivalent system of co-ordinates oriented with respect to the mean azimuth[1] of the Great Pyramid. All the necessary data—Petrie's original co-ordinates and the new equivalent Pyramid azimuth co-ordinates—are given in relation on Plate XIX, to enable the mathematical reader to check the conversion for himself.

Tabulation of conversion.

The special feature of Petrie's Pyramid base and socket corner distances.

Subtraction of related co-ordinate units of Plate XIX—*i.e.* for co-ordinates from the same base and on the same straight line—and conversion of the units into British inches give all the Pyramid's true azimuth base distances shown on Plate XX. Plate XX also shows Petrie's oblique distances between base points and diagonal corners of sockets. The latter

[1]For Plate XX, the azimuth of a line running true North—or of the perpendicular to a line running true East and West—is defined as 0°. The azimuth of a line West of true North is defined as (−) angle from true North line. The azimuth of a line East of true North is defined as (+) angle from true North line.

The azimuth of the Pyramid's base diagonals as defined by the corners of the rock-cut sockets is −0° 3′ 43″.

distances are not stated with reference to any common azimuth. They are nothing more, in each case, than the direct distance in a straight line between two stated points. In this form, Petrie's distances are not a suitable basis for the analytical investigation of all the related data.

In this form not generally suitable for analysis.

¶ 142. THE SIGNIFICANCE OF PETRIE'S PYRAMID BASE DISTANCES.

Their one significant analytical application.

In one application, however, Petrie's base distances are of direct value for analysis. They determine the existing form of the square defining the central extent of base hollowing-in. This is the square RQPS on Plate XX.

The existing distorted definition of an intended or original square:— 9069.4 B″. 9067.7 B″. 9069.5 B″. 9068.6 B″.

The North side, QP, of this square = 9069.4 B″, and defines the line of CD where casing was found and surveyed.

The East side, PS, of this square = 9067.7 B″, and defines the line of EF where casing was found and surveyed.

The South side, RS, of this square = 9069.5 B″, and defines the line of GH where casing was found and surveyed.

The West side, RQ, of this square = 9068.6 B″, and defines the line of BA where casing was found and surveyed.

The close agreement of the North and South measurements, 9069.4 and 9069.5 B″ respectively, and the variation of 0.9 B″ between the East side (9067.7 B″) and the West side (9068.6 B″) suggest—

Intended or original value, 9069.5 B″.

(1) That the North and South measures define the intended or original value as 9069.5 B″; and

Variations due to workmen's errors or subsidence movement.

(2) That the shorter measurements of the East and West sides, 1.8 B″ and 0.9 B″ respectively, less than 9069.5 B″ indicate workmen's errors in building; or

(3) That reduction of the original central base distance between the North and South base edges—*i.e.* between CD on North face and GH on South face—is due to the drawing-in effect of a large cavern subsidence in the natural rock below the Pyramid, and to the major axis of this subsidence running in a direction approximately South and North.

Accuracy of detail,

Workmanship evidences,

Variation due to subsidence distortion.

The minute accuracy of detail in the finishing of beds, joints, and external surfaces of the Pyramid, and the remarkable precision of workmanship evidenced by the tightly fitting blocks, seem to indicate that the same minute accuracy and precision of workmanship extended to the external form of the Pyramid as a whole. In such event, the existing variation in the base distances is due to distortion by subsidence.

¶ 143. THE GENERAL EVIDENCE CONCERNING PYRAMID SUBSIDENCE.

Now if the slightly shorter distance between the North and South base sides, as compared with the distance between the East and West base sides, is

due to the subsidence effect inferred, the Great Pyramid should contain the following indications of such subsidence :— **How subsidence movement would affect Pyramid :—**

(1) The courses of the Pyramid masonry should indicate a slight dip inwards, towards the centre. **Inward dip of courses,**

(2) The existing top platform of the Pyramid masonry should not be truly central to the Pyramid's base square, unless in the remarkably accidental case of the axes of subsidence crossing below the Pyramid's base centre, and possessing the same orientation as the Pyramid base. **Top platform square not central.**

(3) The angle of the Entrance Passage with the horizontal in a Northerly direction should be greater than the angle of the Ascending Passage with the horizontal in a Southerly direction—presuming both to have been of the same inclination originally. **Descending Passage steeper ; Ascending Passage flatter,**

(4) The angle of the Entrance Passage, continued as the Descending Passage, should increasingly accelerate its angle of dip after it leaves the masonry courses, and as it descends further into the natural rock. **Descending Passage increasingly steeper in natural rock,**

(5) The Chambers within the Pyramid masonry should be buckled and crushed in such direction of distortion as agrees with the approximate North and South direction of the major axis of subsidence indicated by the Pyramid's external variations. (¶ 142 (3).) **Distortion and fractures in chambers.**

Every one of the five indications outlined are defined by the existing state of the Great Pyramid's masonry as surveyed and measured by Professor Petrie. The external and internal evidences of subsidence are discussed in detail in Sections II and III of this Chapter. **All above effects exist in Pyramid, observed and measured by Petrie.**

¶ 144. THE PURPOSE OF THE PYRAMID'S SOCKETS.

Petrie has shown that the four corner sockets of the Great Pyramid were primarily cut to fix the alignments of the two diagonals of the Pyramid base. In three cases the alignments of the diagonals are fixed by the outer corner of each of three sockets, L, K, and M, for the N.W., N.E., and S.E. sockets respectively, as figured on Plate XX. In the case of the S.W. socket, the socket surface was carried to UX, 17½ inches to the West of the point Z on the diagonal ZK. The point Z, defining the diagonal alignment is, however, indicated by a chiselled line WZ cut by the original workers for this purpose. **Sockets cut to define base diagonal alignments prior to construction. The chiselled line on the S.W. socket.**

As shown on Plate XX, the true East to West distance from East side of S.E. socket to West side of S.W. socket—*i.e.* between M and the line UX produced—is 9140.63 B″. Petrie gives the oblique distance XM as 9141.4 B″. Now the true geometrical Pyramid base side $\frac{36,524.24}{4}$ P″ = 9131.06 P″ = 9141.1 B″. From this it is obvious that this distance over the two sockets was the original setting-out dimension for the corner to corner distance of the Pyramid's base side. **Distance between East side of S.E. socket and West side of S.W. socket set out prior to construction to define width of Pyramid base square of 36,524 P″ circuit.**

Actual shortening of Pyramid North base side 0.47 B″ on true azimuth.

The existing distance is 0.47 B″ shorter than the true distance. In the same way the sum of the true azimuth co-ordinates between AB and EF (Plate XX), at the centre of the base, is 9068.83 B″ or 0.62 B″ shorter than the mean of the measurements indicated as original by the distorted oblique distances QP and RS, 9069.4 and 9069.5 B″ respectively. (¶ 142.) The shortening effect on base measurements due to subsidence would naturally be greatest across the centre between two opposite base sides. In consequence, we may take the shortening of North base as not greater than the mean of the other two variations noted, $\frac{0.47+0.62}{2}=0.54$ B″.

¶ 145. THE ORIGINAL SETTING-OUT LINES OF THE PYRAMID BASE.

Existing base diagonals as defined by existing sockets slightly distorted from the rectangular owing to subsidence distortion.

Correction to rectangular gives four true squares defining original socket corners of base diagonals.

Also defines as original one true corner and one true base side of 36,524 P″ square circuit.

As stated by Petrie, the existing definition of the base diagonals—owing to subsidence distortion—does not give precisely rectangular diagonals. The amount of error from true rectangular diagonals is shown by the azimuth co-ordinates of the half diagonals on Plate XX. The intentional or original setting out can be very closely approximated by taking the existing North base socket distance LK (+its correction of ¶ 144, *i.e.* 0.54 B″) and the existing South base socket distance ZM (+its correction of ¶ 144, *i.e.* 0.47 B″), and by taking O the centre of the base as fixed; then with these as data we can correct the angles LOK and ZOM each to a right angle, to give the closely approximate true original socket corners L, K, M, and Z.

The result is that the half diagonals OL, OK, OM, and OZ to the socket corners L, K, M, and Z respectively, are defined by four true squares respectively of length of side 4567.41 B″, 4562.10 B″, 4570.55 B″, and 4553.05 B″. The result is confirmed, not only as to its supplying the original intention, but as to its definition of the original construction, by the S.E. socket corner M becoming the precise corner of the Pyramid square base of 36524.25 P″ circuit. The azimuth distance between UX produced and the S.E. socket corner M is also the length of the base side for the Pyramid circuit 36524.25 P″.

The original setting-out arrangement.

The Pyramid was therefore set out in preliminary lines as follows:—

(1) The socket corners defined the lines of the base diagonals.
(2) One socket corner (the S.E.) defined the S.E. corner of the Pyramid.
(3) The distance between the East side of the S.E. socket and the West side, UX produced, of the S.W. socket defined the South base side of the Pyramid.

¶ 146. THE TWO VERSIONS OF PYRAMID RECONSTRUCTION.

Comparison of Professor Petrie's casing corner blocks with the casing corner blocks resulting from the new reconstruction.

Remembering that Professor Petrie's reconstruction defines the hollowing-in of the core without applying the same feature to the casing, and that the new reconstruction, adopted in the present work, applies the hollowing-in to

the casing, the reader will find instructive matter in the details of Plates XXI and XXII. These show the appearance of the South-East corner casing stone according to the two different reconstructions.

Sockets and foundation deposits.

It should be understood that Petrie carries down the masonry of the corner casing stones to the socket floors in all cases. The discovery of the Lisht Pyramid sockets and their foundation deposits (refer Section III, ¶ 197a) may have caused Professor Petrie to modify his reconstruction in this detail. But even this modification could scarcely redeem the evident weakness of his reconstruction as applied to the South-East socket corner casing stone. A reconstruction stands or falls under its critical application to detail. Apart, then, from the identities established concerning the intentional circuit of the Pyramid's base, we are assured that a critical technical examination of the two reconstructions, as applied to the detail of Plates XXI and XXII, will settle the matter conclusively, to the satisfaction of the thesis advanced in the present work.

Lisht Pyramid sockets.

The importance of the comparison of the two reconstructions.

¶ 147. THE EFFECT OF SUBSIDENCE ON FORM OF PYRAMID'S BASE.

The nett effect of the correction of the right angles of the base diagonals in ¶ 145 is as follows :—

Rectangular correction of diagonals shows that central subsidence has reduced Pyramid's central base width by 0.67 B″ across East to West and 2.10 B″ across North to South.

(1) That subsidence effect has reduced the true azimuth distance *between the centres of* the East and West casing base sides by the total amount of 0.67 inch.

(2) That the same effect has reduced the true azimuth distance *between the centres of* the North and South casing base sides by the total amount of 2.10 inches.[1]

This gives constant original central width across Pyramid base—between any two faces—as 9069.5 B″.

These corrections applied to the distances *between* the hollowed-in base sides give a constant distance of 9069.5 B″, East and West, or North and South, between centres of base sides. The East to West distance given by the existing slightly distorted features of the North and South base sides, as surveyed by Professor Petrie, still gives this value (¶ 142). This indicates that the Pyramid masonry, in centrally sliding slightly inwards, could not very appreciably reduce its external base length owing to the tightly fitting blocks. Externally it compromised by slightly skewing the external form of its base to retain its external base length practically unaltered, and at the same time produce the necessary diminution of azimuth co-ordinates to satisfy the subsidence conditions. This distortion of the external form of the Pyramid base bears relation to the distortion of the socket base only as effect to cause.

Construction of Pyramid ensured that subsidence reduction across centre —between opposite faces —should be a maximum ; but between corners of each base side a minimum —almost inappreciable.

All the data, then, at our disposal combine to show that the external corner to corner measures of the Pyramid remained practically unaltered, although very slightly skewed in direction. At the same time, the effect of

[1]This movement, due to subsidence, is discussed further in Section II (¶¶ 180–182), in light of data emerging from inductions subsequent to the stage here discussed.

PLATE XXI.

RECONSTRUCTION OF THE SOUTH-EAST CORNER CASING STONE

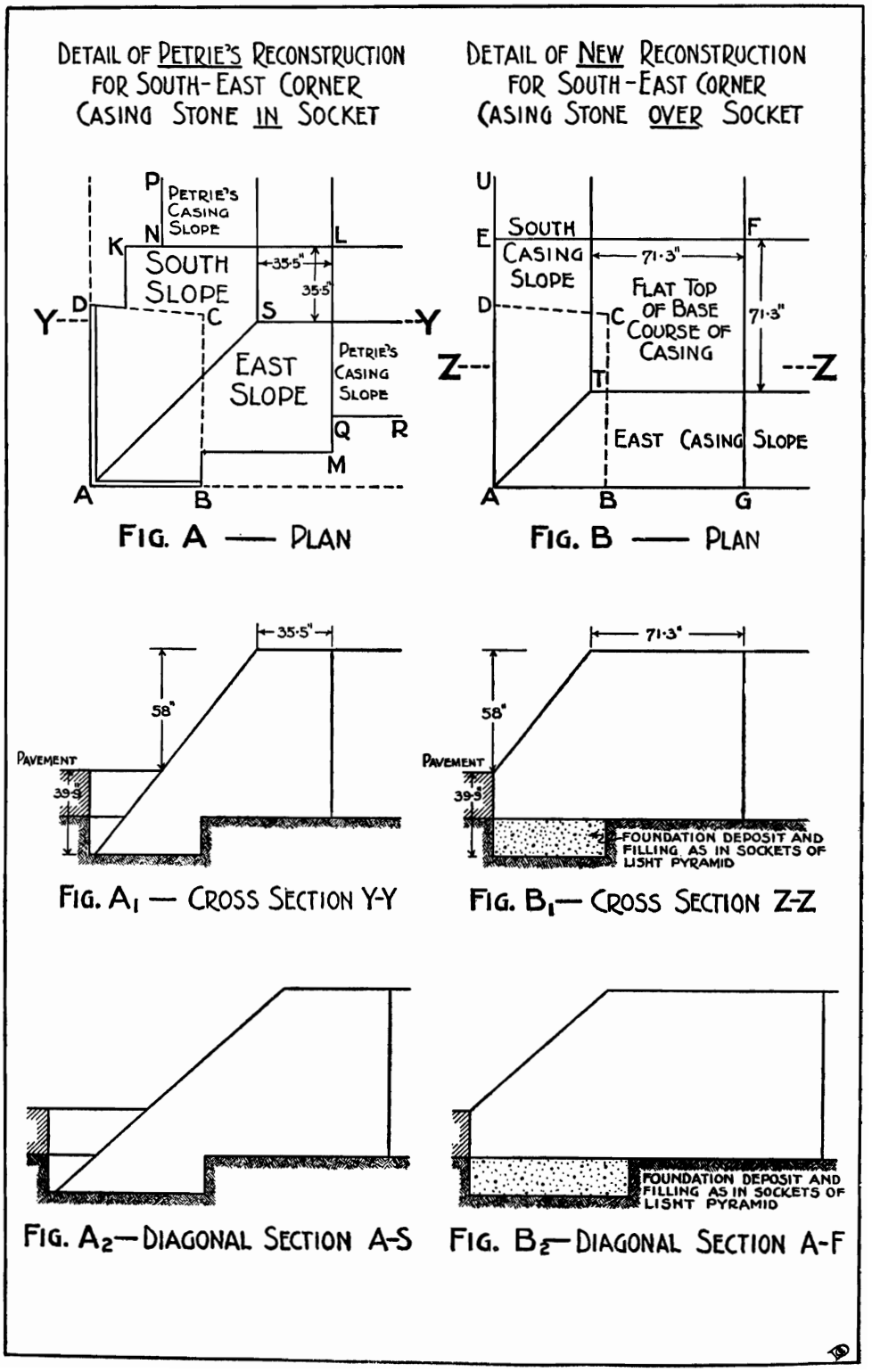


FIG. A — PLAN

FIG. B — PLAN

FIG. A_1 — CROSS SECTION Y-Y

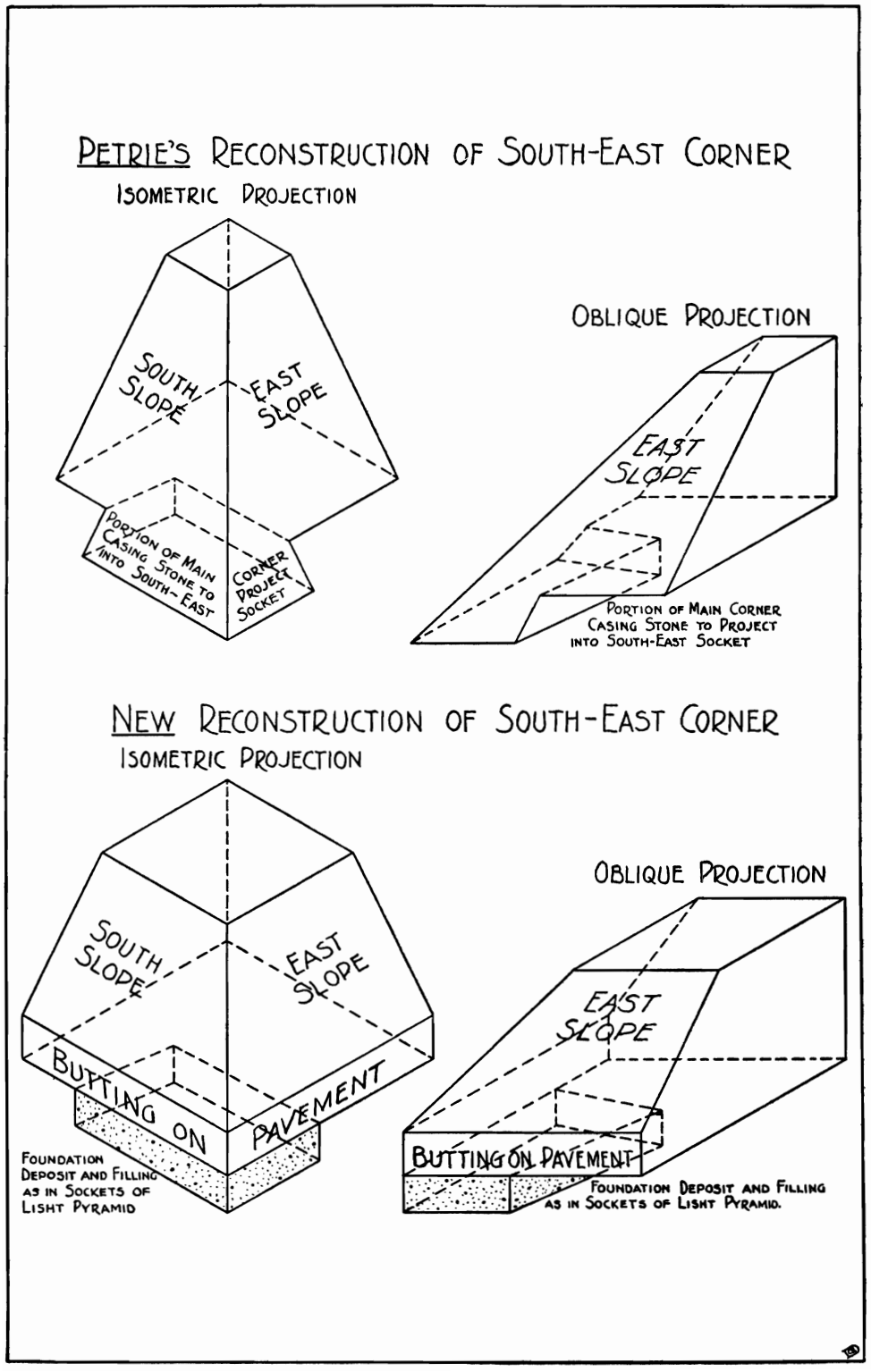
FIG. B_1 — CROSS SECTION Z-Z

FIG. A_2 — DIAGONAL SECTION A-S

FIG. B_2 — DIAGONAL SECTION A-F

PLATE XXII.

ISOMETRIC AND OBLIQUE PROJECTIONS OF SOUTH-EAST CASING STONE RECONSTRUCTIONS.



Explains why core masonry hollowing is 37″ at centre of North face.

the subsidence brought the hollowed-in central portion of the North base and of the South base in each case 1 inch nearer the centre of the Pyramid (¶ 147, Case 2); and in the case of the East and West sides $\frac{1}{3}$ inch nearer the centre of the Pyramid (¶ 147, Case 1). In consequence, the hollowing-in extent of about 36″ would be increased by subsidence to 37″ on North and South base sides, and to 36$\frac{1}{3}$″ on East and West base sides. 37″ is the value obtained by Professor Petrie from his sightings down the North face slope of the core masonry. This agrees with the value deduced for the North face including subsidence effect.

¶ 148. THE PYRAMID'S DISPLACEMENT FACTOR.

Analysis of subsidence movements shows that Pyramid base was defined by a square of 36,524 P″ circuit—corner to corner—and by an inner square marginally 35.76 P″ internal to the other, and of circuit 286.1 P″ less than the circuit of the outer square.

Criticism, therefore, has shown that the Pyramid was set out to a base line of 9141.1 B″, that its distance between centres of opposite base sides was 9069.5 B″, and, independently, that its base sides were centrally hollowed to the extent of about 36″. The difference between the first two values, 9141.1 and 9069.5 B″, gives twice the extent of hollowing-in as 71.6 B″, and therefore the hollowing-in as 35.8 B″=35.76 P″.

The actual Pyramid base circuit is therefore defined by two squares, one marginally 35.76 P″ internal to the other. The outer square, defining the base corners, is 36,524.24 P″ circuit, and the inner square is 8 ×35.76 P″ (or 286.1 P″) less in circuit than the outer square.

286.1 P″ a geometrical measure of the Pyramid.

Now 286.1 P″ (286.4 B″) is an important geometrical value of the Pyramid. It is also the measurement of the displacement of the North to South Vertical Axial Plane of the Pyramid's Passage System Eastwards from the North to South Central Vertical Plane of the Pyramid.

Also the displacement of the Passage System.

The existing displacement of the Passage System, as defined, was measured by Professor Petrie as follows:—

	Petrie's stated possible range of error.
Entrance Door on North Face	=287.0 B″±0.8 B″.
Entrance Passage End in Natural Rock	=286.4 B″±1.0 B″.
Beginning of Ascending Passage	=286.6 B″±0.8 B″.
End of Ascending Passage	=287.0 B″±1.5 B″.

The geometrical definition of external hollowing displacement, Passage displacement, and 35th course axis.

Plates XXIII, XXIV, and XXV (Figs. A, A_1, and A_2) show how the hollowed-in base feature, the 35th course axis, and the displacement of the Passage System are all geometrical functions of a composite system of geometry featuring the solar year to the scale of 10 P″ to a day, and to the scale of 100 P″ to a day. To convey the full significance of this to the reader it is necessary first to define the precise value of the solar year intentionally identified with the Pyramid's base square circuit.

¶ 149. THE INTENTIONAL VALUE OF PYRAMID'S BASE CIRCUIT.

In ¶¶ 102–104 it was shown that the period of 25,826$\frac{1}{2}$ years was identified with the period of the Precession of the Equinoxes. In ¶ 102 it was explained

that $78\frac{1}{2}$ Phœnix cycles gave the identity $25{,}826\frac{1}{2}$ Phœnix years (or intercalated Calendar years) $=25{,}826.54+$Solar years. Accurately, the identity defines the precise numerical values of the Pyramid's base diagonals and of the base square circuit as follows :—

The Phœnix cycle chronology and Calendar rules define the numerical value of Pyramid base square circuit as 36,524.2465 and the numerical values of the sum of the base diagonals (and constant of Precession) as 25,826.542378.

(1) *INITIAL HALF PHŒNIX CYCLE.*

From Table III.	103 years' cycle	=37,620 days
Do. (365 days' column)	61 years of next cycle	=22,280 ,,
	$\frac{1}{2}$ Calendar year	= 180 ,,
	$164\frac{1}{2}$ years on cycle	=60,080 days.

(2) *NO. OF DAYS IN THE PHŒNIX CYCLE.*

From Table III.	3 cycles of 103 years	=309 years	=112,860 days
Do. (365 days' column)	20 years	= 20 ,,	= 7,305 ,,
	Phœnix cycle	=329 years	=120,165 days.

(3) *TOTAL PRECESSIONAL PERIOD.*

78 Phœnix cycles	=25,662 years		=9,372,870 days
From (1) above	$164\frac{1}{2}$,,	=	60,080 ,,
Precessional period	$=25{,}826\frac{1}{2}$ years		=9,432,950 days.

The years are intercalated Calendar years.

(4) *PYRAMID BASE CIRCUIT AND DIAGONALS.*

Let N = No. of days in solar year, and
P = Precessional period in years.

Then from above $$P=\frac{9{,}432{,}950}{N} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (I)$$

and from Pyramid base relationship

$$P=\frac{100\ N}{\sqrt{2}} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (II)$$

Solving the simultaneous equations I and II, we get

$$N=365.2424650 \text{ days.}$$

Then, Pyramid base circuit $=36{,}524.2465\ P''$,
and Sum of Base Diagonals $=25{,}826.542378\ P''$.

These are the values adopted for the geometrical representation developed in Plates XXIII, XXIV, and XXV.

¶ 150. THE PROBLEM AND ITS PLANE.

It has been suggested by the evidence discussed in the two preceding chapters that the external features of the Great Pyramid were intended to

PLATE XXIII.

THE GREAT PYRAMID'S EQUAL AREA GEOMETRY DEFINES DISPLACEMENT OF PASSAGE SYSTEM.

FIG. A.

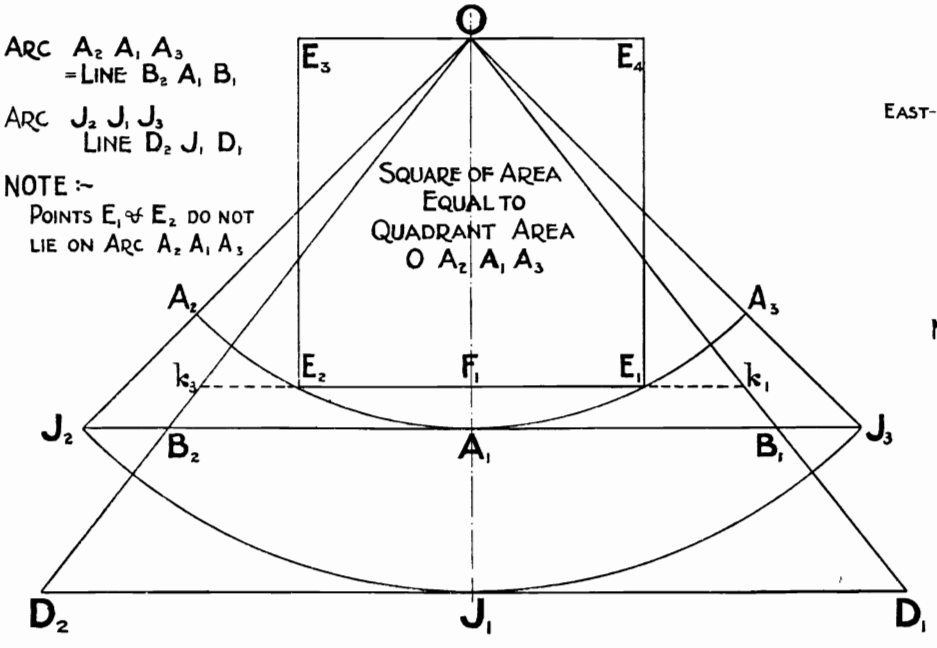
EAST TO WEST VERTICAL SECTION

SQUARE CIRCUIT OF PLANE B_2 A_1 B_1
= SUM OF DIAGONALS OF SQUARE
OF PLANE D_2 J_1 D_1

ARC A_2 A_1 A_3
= LINE B_2 A_1 B_1

ARC J_2 J_1 J_3
LINE D_2 J_1 D_1

NOTE :-
POINTS E_1 & E_2 DO NOT
LIE ON ARC A_2 A_1 A_3



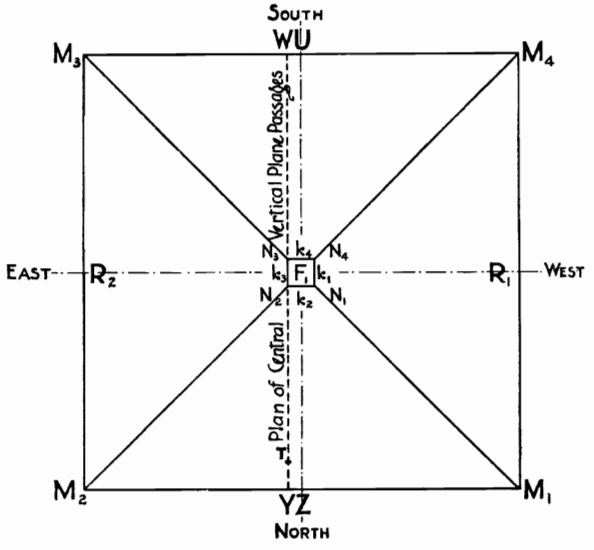


FIG. B.

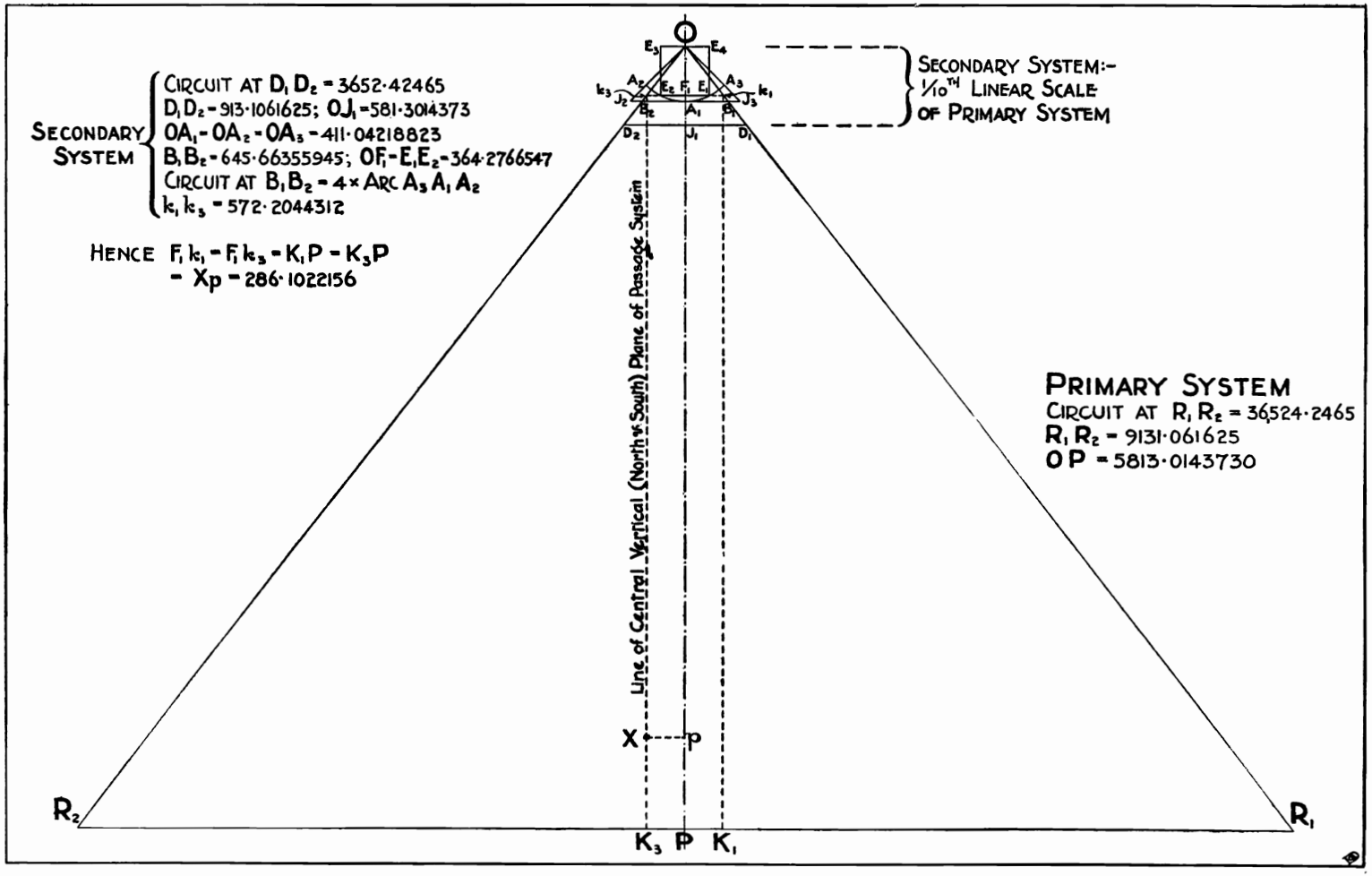
PLAN

CASE I (FIG. A):-
FOR CASE OF $D_2 J_1 D_1$ (FIG. A) = M_2 M_1 (FIG. B),
D_2 D_1 CIRCUIT = 36,524·2465
k_3 F_1 = F_1 k_1 = 2,861·022156 (FIG. A ONLY)

CASE II (FIG. A)
FOR CASE OF $D_2 J_1 D_1$ (FIG. A) = N_2 N_1 (FIG. B),
D_2 D_1 CIRCUIT = 3,652·42465
k_3 F_1 = F_1 k_1 = 286·1022156 (IN FIGS. A & B)

PLATE XXIV.

THE GEOMETRY OF THE PASSAGE SYSTEM DISPLACEMENT.



The plane for graphical representation of Earth's orbit:— The pavement base of the Great Pyramid, since it is the plane containing the square circuit representing the solar year.

form a geometrical representation of the dimensions and motions of the Earth and its orbit (¶ 114). Any such representation must, of necessity, be made with reference to a plane representing the plane of the Earth's orbit. The plane of the Great Pyramid pavement is defined as this natural plane, as it is the plane of the Pyramid's base square, defining the circuit of the solar year. For the necessary geometrical representation the Great Pyramid's base plane, therefore, represents the plane of the Earth's orbit. This, then, is the natural plane for the geometrical and comparative representation of all values defining the dimensions and motions of the Earth and its orbit. These values, in consequence, need only be looked for in relation to the Pyramid's external features as defined in plan.

¶ 151. THE THREE YEAR VALUES.

Complicated factors that simplify the problem of graphically representing the elements of the Earth's orbit.

Consideration of the Earth's motion in its orbit is complicated by several factors. These complications, however, make it a considerably easier matter to specify the intention of any geometrical representation of the elements of the Earth and its orbit. One of the complications referred to is that there are three different year values defining the revolution of the Earth round its orbit. These are the Solar (or Tropical) year, the Sidereal (or Stellar) year, and the Anomalistic (or Orbital year).

Solar year.
Sidereal year.
Anomalistic year.
Perihelion.

The interval between successive autumnal or vernal equinoxes—or between successive summer or winter solstices—defines the Solar year. The interval between the Earth's position, at any time in the year, in relation to the fixed stars, and its next return to that position defines the Sidereal year. The interval between successive annual returns of the Earth to the point—defined as Perihelion—in its orbit nearest the Sun defines the Anomalistic year.

Ascending values of lengths of year:— Solar, ∧ 365¼ days ∧ Sidereal, ∧ Anomalistic.

The Solar year is slightly *less than* 365¼ days, the Sidereal year is slightly *more than* 365¼ days, and the Anomalistic year is slightly longer than the Sidereal year. Were the Earth's axis rigidly constant in its inclination, and in the direction of its inclination, the Solar year would be of the same length as the Sidereal year. Were the plane and axes of the Earth's orbit rigidly fixed in relation to the fixed stars, the Anomalistic year would also be of the same length as the Sidereal year. The Solar and Anomalistic years are therefore departures from the Sidereal year, due to circumstances other than the primary functions governing the Earth's rotation and revolution.

Were the Earth's axis and the ecliptic invariable in direction and inclination, the Solar and Anomalistic Years would be of Length of Sidereal year.

¶ 152. THE SIDEREAL YEAR DATUM.

Relationship suggests that true constructional perimeter of Pyramid base defines Sidereal year; and that this perimeter gives an inner

The Sidereal year is therefore the basal period for the other forms of the year. As such—presuming our premises concerning the Pyramid's purpose to be correct—it should be the year value defined by the true circuit of the Great Pyramid's base. Now the square circuit of the Great Pyramid's base defines the Solar year. This square circuit touches the true Pyramid base at four points only—the four corners. The true circuit of the Pyramid's base is the circuit of the hollowed-in perimeter of the casing base edges. This

circuit is longer than the square (corner to corner) circuit defining the Solar year, and the Sidereal year is longer than the Solar year. In other words, the hollowed-in base circuit is the true constructional base circuit, as the Sidereal year is the true constructional year circuit of the basal dynamics of the Earth's orbit. The question, then, to be settled is whether the hollowed base circuit gives the value of the Sidereal year to the scale of 100 P″ to a day.

geometrical circuit defining the Anomalistic year, as the outer square circuit defines the Solar year.

¶ 153. THE COMPLETED GEOMETRY OF THE GREAT PYRAMID'S EXTERIOR.

Plate XXV illustrates how the representation in plan should indicate the three values of the year. This is derived from the geometrical sequence of Plates XXIII and XXIV in relation to the geometry of the 35th course axis and the *aroura*. The derivation of the 35th course axis connection is illustrated on Figs. A and A_1 (Plate XXV). In Fig. A_1 (Plate XXV), the apex Pyramid circuit at level acb=3652.42465 P″, and this is equal to the apex Pyramid circuit $D_2J_1D_1$ (Plate XXIV). The connected geometry of the latter defines the displacement of the axis of the Passage System and the displacement of the central hollowing-in of the Pyramid's base sides. The circuit of the apex Pyramid at acb (Plate XXV, Fig. A_1) is therefore equal to the 35th axis length EG=FH (Plate XXV, Fig. A). The rectangular *arourae* defined by the latter are EGRC and EFQC, and these are respectively equal in area to the *aroura parallelograms* EGBH and EFAD (the two horizontally shaded areas of Plate XXV, Fig. A). The two latter define the centrally hollowed-in area as DEH, in elevation on Fig. A, and as $D_1E_1H_1$ in plan, Fig. B, Plate XXV.[1] The maximum extent of hollowing-in (35.762777 P″ horizontally from the geometrical plane face of the Pyramid's slope) applies to the whole area DEH (Fig. A), and along the line EO (Fig. A) to the base of the apex Pyramid at c (Fig. A_1). The broadly fluted (or scooped-leaf) effect necessary to taper off the hollowing towards the apex is illustrated on Figs. A_1 and A_2 (Plate XXV).

Development of the above indication synchronises with external geometrical features of Pyramid.

The 35th course axis width and the aroura define the width of central hollowing-in of base sides.

Complete geometrical definition of hollowing-in feature between base and apex.

¶ 154. THE THREE ASTRONOMICAL YEAR-CIRCUITS OF THE PYRAMID BASE.

The restoration of ¶ 153 is the one restoration that satisfies all the structural and geometrical features of the Great Pyramid. The real test of its having been the intentional geometrical arrangement is the extent to which it satisfies the conditions postulated in ¶¶ 150–152.

The above geometrical definition satisfies conditions postulated for representation of three forms of the year.

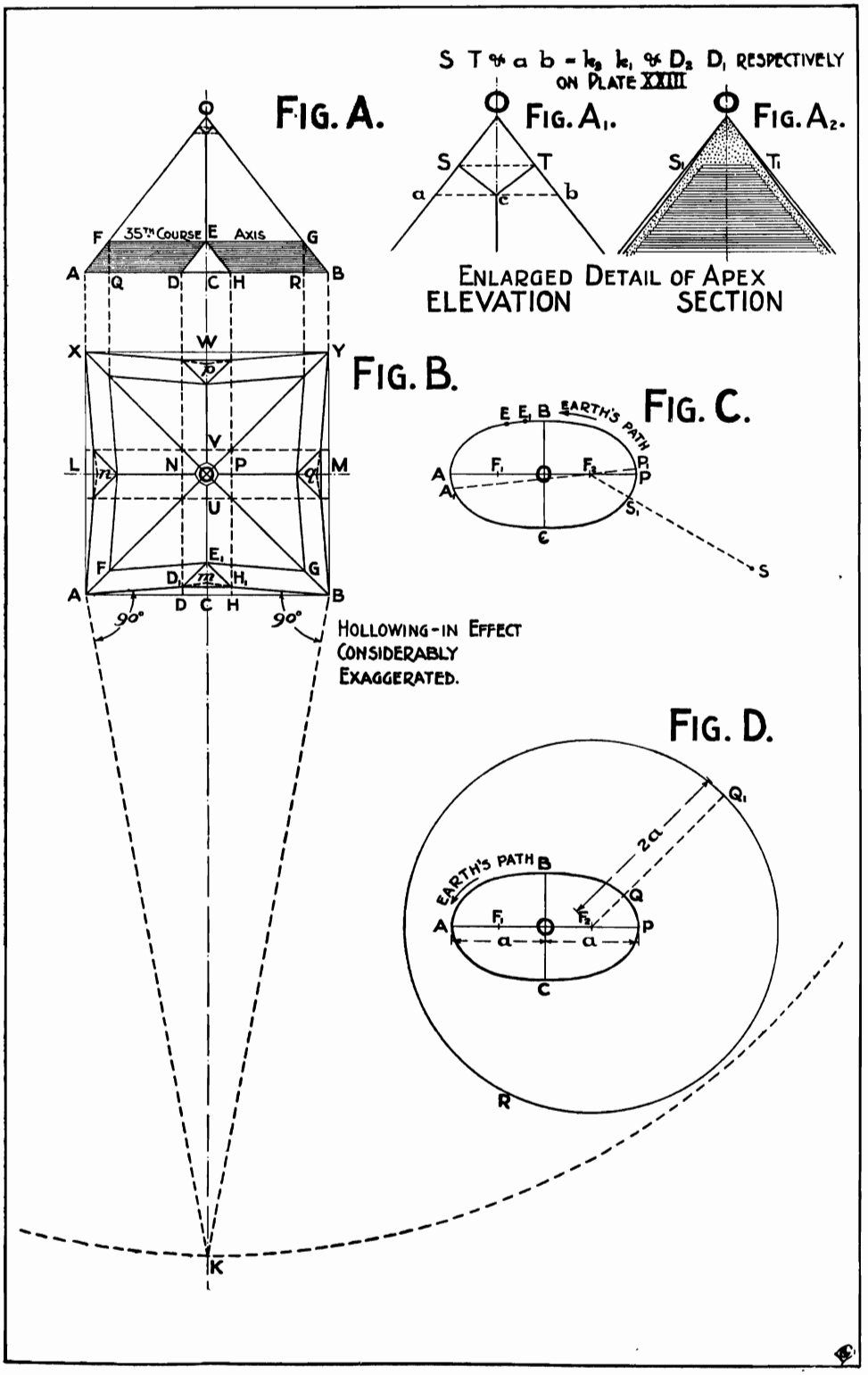
These conditions were—

(1) That the actual (hollowed-in) structural circuit (AD_1H_1B, etc., in Fig. B, Plate XXV) of the Pyramid's base should give the value of the Sidereal year to a scale of 100 P″ to a day ; and

[1]For the relation between point G on Plate XX, as there defined, and point D on Plate XXV, as there defined, the reader is referred to the further discussion on subsidence effects in Section II, ¶¶ 180–182.

PLATE XXV.

THE PYRAMID BASE DEFINES THE EARTH AND ITS ORBIT, IN DIMENSIONS AND MOTION.



(2) That the geometrical circuit (AmBqYpXnA in Fig. B, Plate XXV), internal to the structural circuit, and defined by it, should give the value of the Anomalistic year to the scale of 100 P″ to a day, precisely as the external geometrical circuit (ADCHB, etc., Fig. B, Plate XXV) gives the value of the Solar year to this scale.

Solar year base circuit 36,524.2465 P″.

Now the external geometrical base circuit, as defined, is 36,524.2465 P″, representing, to the scale defined, a good average value for the Solar year for a long period of history from ancient to modern times.

Sidereal year base perimeter, 36,525.647 P″.

The actual structural base circuit, as defined, and resulting from the geometry described, is 36525.6471536 P″, representing, to the scale defined, a good average value for the Sidereal year. The resulting value of 365.256471536 days for the Sidereal year is only 8.6 seconds of time longer than the value for the present time,[1] 365.25637 days.

Anomalistic year base circuit, 36,525.997 P″.

The internal geometrical base circuit, as defined, and resulting from the geometry described, is 36525.997317 P″, representing, to the scale defined, a good average value for the Anomalistic year. The resulting value of 365.25997317 days for the Anomalistic year is only 33½ seconds of time longer than the value for the present time,[1] 365.2595844 days.

Suggests that intention of above representation would be completely expressed by other connected dimensional values of Earth's orbit.

In a representation intentionally giving the values stated, one would expect the intention to be emphatically declared by the associated representation of other related values. So far, the Pyramid's base geometry defines the Earth's annual orbit, in terms of its three forms of year. The intention would be completely defined by the connected representation of the related astronomical knowledge concerning the dimensions and form of the Earth's orbit. (Refer ¶¶ 114 and 120.)

¶ 155. ASTRONOMICAL RELATIONSHIP OF THE THREE FORMS OF THE YEAR. (Plate XXV, Fig. C.)

Earth's elliptical orbit.

The path or orbit of the Earth round the Sun is an ellipse, ACPB, of which F_1 and F_2 are the two foci. The Sun's centre is at the focus F_2. O is the centre of the orbit. AOP is the major axis, and BOC the minor axis of the elliptic orbit.

The Sun in one focus.

Major Axis.

Minor Axis.

Earth's elliptic orbit nearly a circle.

The ellipse figured is considerably exaggerated as a representation of the Earth's elliptical orbit. The latter, to any ordinary scale of representation, cannot be distinguished from a circle.

Perihelion.

When the Earth is nearest the Sun it is at P—on the major axis—whence P is called Perihelion.

Aphelion.

When the Earth is farthest from the Sun it is at A—also on the major axis—whence A is called Aphelion.

[1]For further explanation and additional data concerning the astronomical relationship of the three forms of year—and for data concerning their variations—the reader is referred to Chapter IV, Section II, and Plates XLIV–LVI inclusive.

Direction of Earth's motion in its orbit.

The Earth travels round its orbit in the direction of the arrow, *i.e.* direction BACPB.

Sidereal year explained.

Now let S be a fixed point in the heavens, and E the equinox for a particular year. Owing to a slow movement of the Earth's axis,[1] the equinox of the following year does not occur at E, but at a point E_1, about 50″ of angle (or 20 minutes of time) short of E. The Solar year is therefore the interval in days taken by the Earth to travel round the distance $EACPBE_1$, whereas the Sidereal (or Stellar) year—fixed from the immovable point S, and its immovable radius F_2S_1S—is the interval in days taken by the Earth to travel round the distance S_1PBACS_1.

Why Solar year shorter than Sidereal year.

About 50″ of angle or 20 minutes of time shorter.

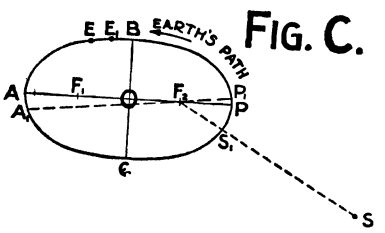


FIG. C.

The Solar year is therefore shorter than the Sidereal year by the interval E_1E—about 50″ of angle, or about 20 minutes of time.

Anomalistic year explained.

The Equinox is not, however, the only point that moves. In the course of the Earth's revolution round its orbit, the orbit itself is not stationary, but moves round in the direction of the Earth's revolution. In the course of one revolution of the Earth round its orbit, the major axis AF_2P moves round to the position $A_1F_2P_1$. Hence, commencing, say, from perihelion at P, the Earth travels round $PBACPP_1$ to return to perihelion. This revolution defines the Anomalistic or Orbital year. It is longer than the Sidereal year by the time it takes the Earth to travel from P to P_1. PP_1 is about 11.5″ of angle, or about 4.6 minutes of time. (Refer also Plates LV and LVI.)

Why Anomalistic year longer than Sidereal year by about 11.5″ of angle or 4·6 minutes of time.

¶ 156. THE MEAN SUN DISTANCE AND THE EARTH'S ORBITAL MOTION. (Plate XXV, Fig. C.)

F_2P = the shortest distance between the Earth and Sun.
F_2A = the longest ,, ,, ,, ,,

The mean of these is OP = OA, and this distance, in astronomical nomenclature, is defined as the *mean sun distance.*

Eccentricity (e) of elliptic orbits.

The eccentricity of the elliptic orbit is

$$e = \frac{OF_2}{OP} = \frac{OF_1}{OA} = \frac{F_1F_2}{AP}.$$

Mean Sun distance = semi-major axis.

Value for Earth's orbit. 1900 A.D. e = 0·016751.

Maximum value about 11,600 B.C., e = about 0.019.

Minimum value about 26,000 A.D., e = about 0.004.

The value of this eccentricity (e) is variable. Its value for 1900 A.D. is 0.016751. Its greatest value during the past 60,000 years occurred about 11,600 B.C. It was then something over 0.019. Since that time it has been slowly but constantly diminishing, and will continue to diminish until about 26,000 A.D. The value of e will then be about 0.004, when the Earth's orbit will be as nearly a circle as it is ever likely to be.

[1]For explanation of this movement refer Chapter IV, Section II, and Plates Nos. XLIV–LVI inclusive.

To determine accurately the functions of the year, at any period, knowledge of these and other values, as well as of the laws governing motion in elliptic orbits, is a matter of fundamental necessity. Without going extensively into the subject of the Laws of Planetary Motion, attention is directed to an important corollary of these laws which has an important bearing upon the question of the Sun's mean distance.

Knowledge concerning these and other values, and their variations, and the laws governing same, of fundamental necessity.

¶ 157. THE MAJOR AXIS OF THE ORBIT A DYNAMICAL CONSTANT. (Plate XXV, Fig. D.)

In Fig. D, ABPC is the elliptic orbit of Fig. C, with the Sun in focus F_2.

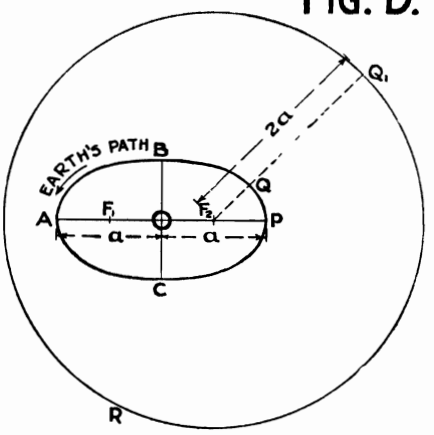
Definition of the "Earth's Speed Circle."

In Fig. D let OA = OP = a.

Then AP = 2a = Major axis.

With centre F_2 at the Sun, and radius F_2Q_1 = AP = 2a, describe the circle Q_1R.

FIG. D.



The corollary to which attention is directed is as follows:—

The speed of the Earth round its elliptic orbit is at every point, such as Q, equal to the speed which the Earth would acquire in falling to the ellipse at Q, from Q_1 on the circumference of a circle (Q_1R) with centre at the Sun (F_2), and radius (F_2Q_1) equal to the major axis (AP) of the elliptic orbit.

The period of the Earth's revolution round its orbit "independent of every element except the major axis."

Thus the speed of the Earth at Q in the elliptic orbit is equal to the speed the Earth would acquire at Q in falling towards the Sun from Q_1 to Q.

From this it follows that "*the period*" of the Earth's revolution round its orbit is "*independent of every element except the major axis.*"[1]

For purpose of brevity, rather than accuracy of definition, we will term the circle Q_1R the "Earth's Speed Circle."

¶ 158. THE GEOMETRICAL REPRESENTATION OF THE RANGE OF VARIATIONS IN RELATION TO THE BASAL CONSTANT.

The single constant geometrical feature of the Earth's orbit is therefore the Earth's "Speed Circle," with its centre occupied by the Sun. Referring again to Fig. D of Plate XXV, we see that the Earth's orbit ABPC revolves in an anti-clockwise direction about the fixed point F_2, defined as the centre of the Sun, and the centre of the Earth's Speed Circle RQ_1. Thus the point O

The Earth's "Speed Circle" the only constant feature of orbit.

All points of orbit slowly revolve round heliocentric focus of orbit.

[1]Refer Moulton's "Celestial Mechanics," pp. 150–151.

Heliocentric focus the fixed centre of the Earth's "Speed Circle."

The history of an orbit's motions and dimensions cannot be depicted by an ellipse.

describes a circle around F_2. Points P, F_1, and A on the major axis, and points B and C on the minor axis, also each describe their independent circles around F_2 as centre. None of these points, then—other than the fixed centre of the Sun, F_2—can be deemed as suitable for the origin of co-ordinates for any graphical representation of the Earth's orbit defining the limits of its movements and variations. Nor, indeed, can the orbit for any particular date be graphically represented as defining in general geometrical terms the limiting values of orbital cycles.

Two circles, both concentric with, and internal to, the Earth's "Speed Circle," define the annular zone of variation of the centre of the Earth's orbit.

Now, since the distance F_2O is a variable distance, and since O rotates around F_2 as a fixed centre, it is clear that a circle of radius F_2O, minimum value, and an outer circle of radius F_2O, maximum value, completely define the limits of variation of the centre of the orbit from the Sun. During the long period of the rotation of the orbit round the Sun (over 108,000 years) the curve traced by the centre point O of the orbit lies within the ring defined by the maximum and minimum circles.

The three heliocentric circles completely define in geometrical terms the historical range of the orbit's motions and dimensions.

These two circles, together with the Earth's "Speed Circle"—all concentric with the Sun—completely define, in general geometrical terms, the fixed element of the Earth's orbit—*i.e.* its major axis—and the range of variation of the variable elements. A representation of this nature is the necessary geometrical basis for any further representation defining the variable elements in relation to any standard system of astronomical chronology.

¶ 159. GREAT PYRAMID'S EXTERNAL GEOMETRY DEFINES THE EARTH'S ORBIT AND ITS VARIATIONS.

Geometrical definition of limiting values of eccentricity (e).

With e = eccentricity of Earth's orbit, then (Fig. D of Plate XXV) :—

$$\text{Maximum value of } e = \frac{\text{Diameter of max. circle of radius } F_2O}{\text{Radius } (F_2Q_1) \text{ of Earth's Speed Circle}},$$

and

$$\text{Minimum value of } e = \frac{\text{Diameter of min. circle of radius } F_2O}{\text{Radius } (F_2Q_1) \text{ of Earth's Speed Circle}},$$

F_2O being variable within its defined limits, and F_2Q_1 being a constant = the major axis of the Earth's orbit = AOP.

The geometry of the Pyramid's base plan gives the above complete definition.

Now the two limiting values of e are known, and are precisely defined by the proportions of the Pyramid base geometry shown in Fig. B, Plate XXV. In this representation (Fig. B), the base centre, O, represents the Sun's centre. NOP and UOV represent the rectangular diameters of the minimum circle passing through NVPU. These diameters are defined by the central hollowing-in widths of the Pyramid base sides. The maximum circle is defined by the circle, CLWM, inscribed within the Pyramid's geometrical base square. Its diameter is the Pyramid base side length, LOM or WOC.

The radius of the Earth's "Speed Circle" is defined by the distance, OK, K being the intersection of the perpendiculars, AK and BK, from the con-

verging base side lengths, AD_1 and BH_1 respectively. Other points such as K are defined by all four sides of the Pyramid's base, this definition completing the circuit of the Earth's " Speed Circle." The radius OK of this circle, by geometrical construction, is 470860.606 P″. The diameter VOU of the minimum circle, by geometrical construction, is 1826.212325 P″, and the diameter of the maximum circle is 9131.061625 P″.

Pyramid's definition of Earth's " Speed Circle " and related maximum and minimum values of eccentricity.

From these values—

$$\text{Minimum value of } e = \frac{VOU}{OK} = \frac{1826.212325}{470860.606} = 0.00387814$$

and

$$\text{Maximum value of } e = \frac{WOC}{OK} = \frac{9131.061625}{470860.606} = 0.01939207.$$

Pyramid's Minimum e and Maximum e.

These values are respectively the least and the greatest possible values of e—the eccentricity of the Earth's orbit—as accurately as modern astronomy can determine these values.

Pyramid's " Speed Circle " radius $\frac{1}{25,000,000}$th of Earth's " Speed Circle " radius.

Again,

$$\begin{aligned} \text{radius OK} &= 470{,}860.606 \text{ P}'' \\ &= 471{,}378.552 \text{ B}'' \\ &= 7.43968674 \text{ miles.} \end{aligned}$$

Pyramid's relative scales of definition of Earth's polar radius and " Speed Circle " radius, $\frac{1}{250,000,000}$ and $\frac{1}{25,000,000}$.

This distance, multiplied by 25,000,000

$$\begin{aligned} &= 185{,}992{,}169 \text{ miles,} \\ &= \text{Major axis of Earth's orbit,} \\ &= \text{Twice Mean Sun Distance.} \end{aligned}$$

Whence Mean Sun Distance = 92,996,085 miles.

Pyramid value for Sun's Mean Distance, 92,996,085 miles.

Professor Simon Newcomb[1] gives for the latter a mean value of 92,998,000 miles.

Thus we have found (¶¶ 101 and 114) that

$$1 \text{ Pyr. inch} = \frac{1}{250,000,000} \text{ Polar radius of Earth,}$$

and that Pyramid's " Speed Circle " radius OK

$$= \frac{1}{25,000,000} \text{ Radius of Earth's " Speed Circle."}$$

The scales are therefore decimally related, as we had inferred they would be in a representation of this nature (¶ 114).

For modern variations in the determination of the value of the Sun's Mean Distance, the reader is referred to Section III, ¶ 201.

[1]Enc. Brit. (11th Edit.), Vol. XXI, p. 717, Table I.

SECTION I.—SUMMARY AND CONCLUSIONS.

¶ 160. THE GEOMETRICAL EXPRESSION OF NATURAL LAW.

Pyramid's Polar diameter inch intentional.

The Great Pyramid has now clearly established its intention in regard to its inch-unit. It defines that this unit is a Polar diameter inch-unit of the value of one 500-millionth part of the Earth's Polar diameter.

Its use defines all Earth and orbital distances and motions as simple functions of the Earth's Polar diameter and the year.

In conjunction with a simple, yet extensive system of solid geometry, the Pyramid inch-unit, as applied to the dimensions and form of the Pyramid's exterior, defines a further intentional representation. This is to the effect that all dimensions (angular and linear), and all motions—as well as variations in these dimensions and motions—of the Earth and its orbit, are simple functions of the Earth's Polar diameter and of the period of the Sidereal Year in solar days. In other words, the Great Pyramid's external system of geometry is the graphical expression of the Natural Law relationship inferred from the mathematical clue of the four Pyramid constants that defined, by the noon reflexion phenomena, the principal points of the year (¶¶ 46 and 47).

This definition is the Natural Law relationship inferred from the reflexion phenomena.

Intentional presentation in terms of Gravitational Laws.

Numerical value of Pyramid base circuit measurement independent of surveyed measurements, yet agrees with latter.

Defined in terms of known duration of Phœnix Cycle.

The manner in which the Pyramid's base plan simply defines the dimensions and limiting areas of dimensional variations of the Earth's orbit shows clearly that the intention was to present these as governed by the Laws—or, as the Pyramid seems to define, an all-including Law—of Gravitation (¶¶ 157, 158). This comprehensive graphical representation is independent entirely of any question as to the accuracy of any survey or measurement of the Pyramid's base, yet this independent representation agrees precisely with the accurate modern survey measurements. The intentional numerical value of the circuit of the Pyramid base square is defined in terms of the known duration of the Phœnix Cycle, or the Cycle of the House of Enoch (¶ 149). In this connection the relations established in ¶¶ 38 and 39 possess a remarkable numerical significance.

Fragments of the ancient scientific system in use in Egypt before arrival of Pyramid builders.

A fact requiring emphasis, in connection with the use of the Polar diameter inch in the Pyramid, is that this unit and the year circle form the necessary basis for the derivation of the Egyptian common cubit and the Egyptian *aroura*. Nevertheless, the common cubit was in use in Egypt—but without the inch as a contemporary unit—before the Pyramid builders had arrived. This confirms what we have previously seen, that the early Egyptians had derived from the former civilisation a fragment of the science that the designer of the Great Pyramid knew in its entirety.

¶ 161. THE SYMBOLICAL DEFINITIONS OF THE PYRAMID'S BASE CIRCUIT.

Form of Pyramid's constructional base perimeter defines relations of the Earth and its orbit.

Whilst the solid geometrical relations of the Pyramid define the form of the Pyramid's base perimeter, it is the constructional form of the latter that defines, in the plane of the base, all the principal relations of the Earth and its orbit. The Pyramid's base perimeter is defined as a symmetrical figure

formed of twelve lines. Its corners define an external square, and the lines of its perimeter from its corners, when produced to meet inside the centre of each base side, define a symmetrical figure formed of eight lines. (Plate XXV, Fig. B.)

Constructional base perimeter of twelve lines defines circuit of Sidereal year.

The twelve-line figure is the actual constructional base circuit of the Pyramid, and defines the Sidereal year to the scale of 100 Polar diameter inches to a day.

This perimeter defined by and internal to a square defining circuit of Solar year.

The external square circuit of the Pyramid's actual base corners, defines the Solar (or Tropical) year to the scale of 100 Polar diameter inches to a day.

The same perimeter defines an internal circuit of eight lines defining circuit of Anomalistic year.

The eight-line figure defines the Anomalistic (or Orbital) year to the scale of 100 Polar diameter inches to a day (¶ 154).

This is a graphical representation indicating that the Sidereal year is the actual constructional year value of orbital motion, that the Solar year is the *apparent* basal year value, and that the Anomalistic year is the most obscure value of the three. This is an exact representation of an astronomical truth.

The symbolical definition of the three relations.

¶ 162. THE GEOMETRICAL REPRESENTATION OF THE ORBIT'S HISTORY.

The geometry of the Pyramid's base is an exact representation of an astronomical truth, *i.e.* that the speed of the Earth at any point in its orbit can be determined from the following data :—

The Pyramid's base plan defines the framework for the geometrical representation of the history of the Earth's orbit.

(a) A circle with its centre at the focus of the Earth's orbit occupied by the Sun, and of radius equal to the length of the major axis of the Earth's orbit, *i.e.* twice the mean Sun distance ; and

(b) The direction and distance of the free focus of the Earth's orbit in relation to the focus occupied by the Sun.

Definition of Constants :— Length of major axis of orbit ; heliocentric focus.

The Pyramid's base geometry represents the radius and circle of (a) accurately to a scale of $\frac{1}{25,000,000}$ and defines the annular field of (b) to the same scale. The latter representation (*i.e.* of (b)) may be described as the definition of the orbital field of the free focus. The orbit of the free focus is completed in each cycle of about 21,000 years. The orbits of a series of such successive cycles, owing to the variation in the distance of the free focus from the heliocentric focus, completely traverse the annular zone between its circle of minimum radius and its circle of maximum radius.

Definition of annular zone containing all possible positions of the free focus of the orbit, thus defining limits of variation of orbit's eccentricity.

The radius of the constant circle of (a) above precisely represents the value of the constant length of the major axis of the Earth's orbit. Consequently, it represents the Sun's mean distance as half this value. The Sun's mean distance is, therefore, represented as a radius, to the scale of $\frac{1}{25,000,000}$, and, as previously shown (¶¶ 101, 114, 159), the Earth's Polar *radius* is represented by the Pyramid inch to the scale of $\frac{1}{250,000,000}$.

Scalar relation between representations of Earth's Polar radius and Sun's mean distance.

¶ 163. THE QUESTION OF UTILITARIAN MOTIVE.

Nothing so far learned of particular value from utilitarian standpoint.

All these and other identities have been established as related identities in this chapter, and in preceding chapters. That they are intentional identities can scarcely now be doubted. But what new item of knowledge have we learned that is of any practical value, from the standpoint of the utilitarian, apart from its interest as pertaining to matters of scientific and archæological curiosity? Very little, indeed, when viewed from the standpoint of any utilitarian basis. We have certainly learned that the dimensions and motions of the Earth and its orbit are all related functions of the simplest units of these dimensions and motions. This, however, we have known in a slightly different form from the Laws of Newton and Kepler. The rational development of Einstein's Theory of Relativity now gives us reason to hope that these and the laws of other branches of science may be shown to be but varying phases of one Universal Law of Nature.

Scientific facts given by Pyramid already known as facts of modern science.

What other motive, if any, lies behind the design and construction of the Great Pyramid?

The most we have learned, then, from the Pyramid's geometry so far—taken as a whole—has not very materially advanced our knowledge of science beyond what we have already known *in general terms*. What we have learned may have caused us to alter our conceptions concerning the origin and development of ancient civilisations. But was this the sole reason that prompted the design and construction of a monument of the nature of the Great Pyramid? Surely there was some utilitarian motive behind a project of this nature.[1]

¶ 164. OMISSIONS THAT SUGGEST POSSIBLE MOTIVES.

Pyramid gives us an ancient geometrical system of Natural Law in relation to the motions of the Earth and its orbit.

Let us consider, then, what are the outstanding features of the facts, from this standpoint of possible motive. The facts have proved to us that a certain stage of world civilisation, at an unknown—or hitherto supposedly undefined—period in the past had evolved a geometrical system of Natural Law, in relation to the motions of the Earth and its orbit, equal to, superior to, or more comprehensive than the modern system of expressing this Natural Law. The facts of importance in this statement of the case are that we have not yet learned anything concerning the precise, or even the approximate date of the stage of civilisation thus made known; and that we have not yet derived a single *tangible* indication as to how the savants of that period discovered their facts of science—*whether by methods of modern times, by methods unknown to modern times, or by the development of faculties now atrophied by long disuse.*

So far it has failed to indicate the date of the civilisation using this system; or as to how the scientific facts were derived.

The Pyramid's design postulates that knowledge of the facts of science defined by the Pyramid must precede the discovery of the Pyramid's definition of these facts.

Another feature that must have become increasingly evident to the careful reader is of equal importance. This is that, in order to discover the scientific facts embodied in the Great Pyramid, it is essential that the investigator should have previous knowledge of these very facts. Was the object of the designer, then, merely to show a later civilisation that the precise science of gravitational astronomy had been known long previously? Was this the

[1]For the evidence against the Tombic Theory refer Section III, ¶ 208 and context.

sole object of a work so vast, and so painstakingly executed in the minutest detail? The fact that the riddle of the Great Pyramid can only be read by one already in possession of the knowledge embodied in its design surely supplies a clear indication of a more utilitarian motive than we have so far seen.

This a clear indication of motive.

¶ 165. THE PYRAMID DESIGNER'S FORETHOUGHT.

To answer the preceding questions we must reach our objective in stages. One thing we have seen to be clear. This is that the designer of the Pyramid deemed he was projecting his knowledge into a future stage of civilisation that could interpret his intention. He foresaw that the contemporary language in which the facts could be conveyed would lose its meaning and idiomatic significance. It might be lost entirely, or at least be capable of mistranslation or misinterpretation. This foresight has certainly been justified.

Pyramid's science intended to be read by a future race to whom the science was already known.

The designer's foresight in not committing his knowledge to writing in any contemporary language.

The design was therefore formulated, without the aid of written expression, to embody in its external features a geometrical symbolism in Earth standard measurements. This symbolism was to be interpreted in an age already in possession of the knowledge embodied in the symbolism projected. The modern elucidation of this symbolism clearly justifies the remarkable forethought that both conceived the future conditions and created the design to meet them. Forethought of this nature was never expended merely to teach a future race of mankind facts of science it already knew.

Geometrical symbolism a universal means of scientific communication.

Earth's Polar diameter a universal scale of measurement.

Forethought justified by the interpretation of the ancient science as defined in these terms.

We are compelled, then, to come to the conclusion that the Pyramid's external features were designed to attract and direct attention to a further message of greater importance. Granting the forethought displayed, of what nature could this further message be? Clearly to tell the future race of mankind what it could not possibly know, or to confirm what could have no other possible physical means of being confirmed. A definitive limiting of future possible knowledge in this way can only relate to a break in the continuity of something essential to a race of mankind possessing the scientific knowledge defined; a break that had taken place before the Pyramid was built, and that could not be restored otherwise than by being passed on from the former civilisation to the then remotely future civilisation.

Such forethought expended in vain unless expended for the purpose of teaching the future race something it could not possibly know.

A vital break in a continuity essential to mankind.

¶ 166. THE INDICATIONS OF A CHRONOLOGICAL CONNECTION.

The inferred break in continuity can only be conceived as relating to some factor affecting the history of the previous civilisation, and related—or that should be related—to the history of the present stage of civilisation. However we look at this aspect of the problem, we are compelled to see that the *primary essential* for restoring the inferred relation must be of a chronological nature. This, indeed, is the one obvious connection suggested by the Great Pyramid's exterior. Here everything is connected with astronomical

The motive suggested inferred as relating to a factor that should be a common factor in the two systems of civilisation.

This inference suggests that the first step in deriving the factor noted is essentially of a chronological nature.

This is confirmed by Pyramid's external indications.

cycles, and astronomical cycles are the only possible means of affording a reliable datum for the chronological relations of two isolated periods of mankind's history.

A standard chronology necessarily defined by astronomical cycles.

Now there are two outstanding astronomical cycles associated with the Pyramid's exterior. There is the cycle of the Precession of the Equinoxes, associated in the Pyramid geometry with a standard period of reference of 25,826.54 Solar years. And there is the cycle of the revolution of the Autumnal Equinox from Perihelion to Perihelion.

The various cycles that could be employed to define such a system :—

The Precessional cycle,

The cycle of motion of Equinox from Perihelion,

The cycle defining variation in eccentricity,

The cycle of the revolution of the instantaneous axis of rotation of the Ecliptic.

There is also the cycle defining the variations in the eccentricity of the Earth's orbit. In addition to these, there is a cycle not hitherto mentioned. This is a cycle defining an important feature of a very slight variation in the Ecliptic due to planetary attractions. The important feature mentioned is what is known as the instantaneous axis of rotation of the Ecliptic. This axis is analogous to the major axis of the Earth's orbit, and, like the latter, has a slow revolution round the orbit. This movement—if its rate during the past 6000 years be taken as basis—completes a revolution of the Ecliptic in about 49,000 years.

¶ 167. DEFINITION OF A SINGLE CYCLE INSUFFICIENT.

The representation of the variable annual values for one cycle not sufficient to define representation as intentional.

A complete and accurate definition of the variable annual rates of any one of the cycles mentioned for every year over a long period of time covering the current years of the present chronological era and the years of a chronological era of past history would be sufficient to effect a chronological connection. It would not, however, suffice to define the representation of the values as intentional. A single representation would always be open to doubt on the grounds of accidental coincidence.

There are also two other reasons why a single representation could not be accepted as certain evidence in the relation mentioned. These are—

Reasons :—

(1) Modern values for ancient times not sufficiently reliable for identity.

(1) That, whilst modern astronomy is very accurate in its definition of the variable annual rates over a period of 600 years of modern time, its values covering a period of 6000 years back from the present are not so reliable ; and

(2) An ancient representation of accurate modern values requires an independent means of defining the representation as intentional.

(2) That, presuming certain remotely ancient astronomers knew the accurate values for their own times, and also knew the accurate values for years of modern times, it would be necessary for them to define both facts in such certain terms as could not fail to be accepted by modern astronomers.

Any chronological definition of present in relation to past history on the Great Pyramid's geometrical system would require to satisfy these conditions.

¶ 168. THE POSSIBLE MAXIMUM DEFINITION.

Scientific zero datum of chronology.

The most scientifically appropriate zero date of any system of astronomical chronology is the date at which longitude of Perihelion is 0°. With

this as basis, definition of intention, and definition of accurate knowledge of the astronomical values of rates and angles for both ancient and modern times would be completely established as follows :— **Longitude of Perihelion, 0°.**

(1) By the representation of a year of past time, which we term Date A, defined in relation to the date at which longitude of Perihelion was 0°, and of a year of present time, which we term Date B, for which the longitude of Perihelion, defining the modern Date B, is given by the representation. **For Dates A and B:— Longitude of Perihelion.**

(2) By the representation of the total angle of Precession between Date A and Date B. **Total Precession.**

(3) By the representation of the angle between the instantaneous axis of rotation of the Ecliptic at Date A, and the same axis at Date B— or by the definition of the longitudes of the axis at both dates, that for Date B agreeing with the modern value. **Longitude Ecliptic instantaneous axis of rotation.**

(4) By the representation of the annual rate of motion of the Equinox in relation to Perihelion for every year from Date A to Date B, the rate for Date B agreeing with the modern accepted rate for Date B. **Annual rates, separation of Equinox and Perihelion.**

(5) By the representation of the annual rate of Precession for every year from Date A to Date B, the rate for Date B agreeing with the modern accepted rate for Date B. **Annual rates, Precession.**

(6) By the representation of the annual values for the motion of the instantaneous axis of the Ecliptic for every year from Date A to Date B, the rate for Date B agreeing with the modern accepted rate for Date B. **Annual rates, Revolution of Ecliptic instantaneous axis of rotation.**

(7) By the representation of the annual values for the eccentricity of the Earth's orbit from Date A to Date B, the rate for Date B agreeing with the modern accepted rate for Date B. **Eccentricity of Earth's orbit.**

(8) By the conversion and integration of the values in (4), (5), and (6), giving accurately the angles defined by (1), (2), and (3). **Integration of rates give same total angles.**

(9) By the values in (4), (5), and (6) not being measured values dependent upon any Pyramid measurer or surveyor, but by their being values that are primarily functions of the Pyramid's external geometry, and that, secondarily, agree with the accurate measurements of a reliable Pyramid measurer and surveyor such as Professor Flinders Petrie (for linear measurements), or Professor Piazzi Smyth (for angular measurements). (Refer Section II, ¶¶ 170-175, regarding the relative value of Petrie's and Smyth's independent measurements.) **All values primarily geometrical Pyramid values, agreeing with accurately measured Pyramid values.**

¶ 169. THE DEFINITION ESTABLISHING INTENTION.

If items (1) to (5) and (8) and (9) are established, the conditions are satisfied as fully as any astronomer could desire.

If item (9) is established, it will be proved that the Great Pyramid s system of geometry is a graphical representation of Natural Law, defining

What would be implied by a definition such as that outlined:—

Restoration of chronological relations with previous civilisation.

Intention of definition established.

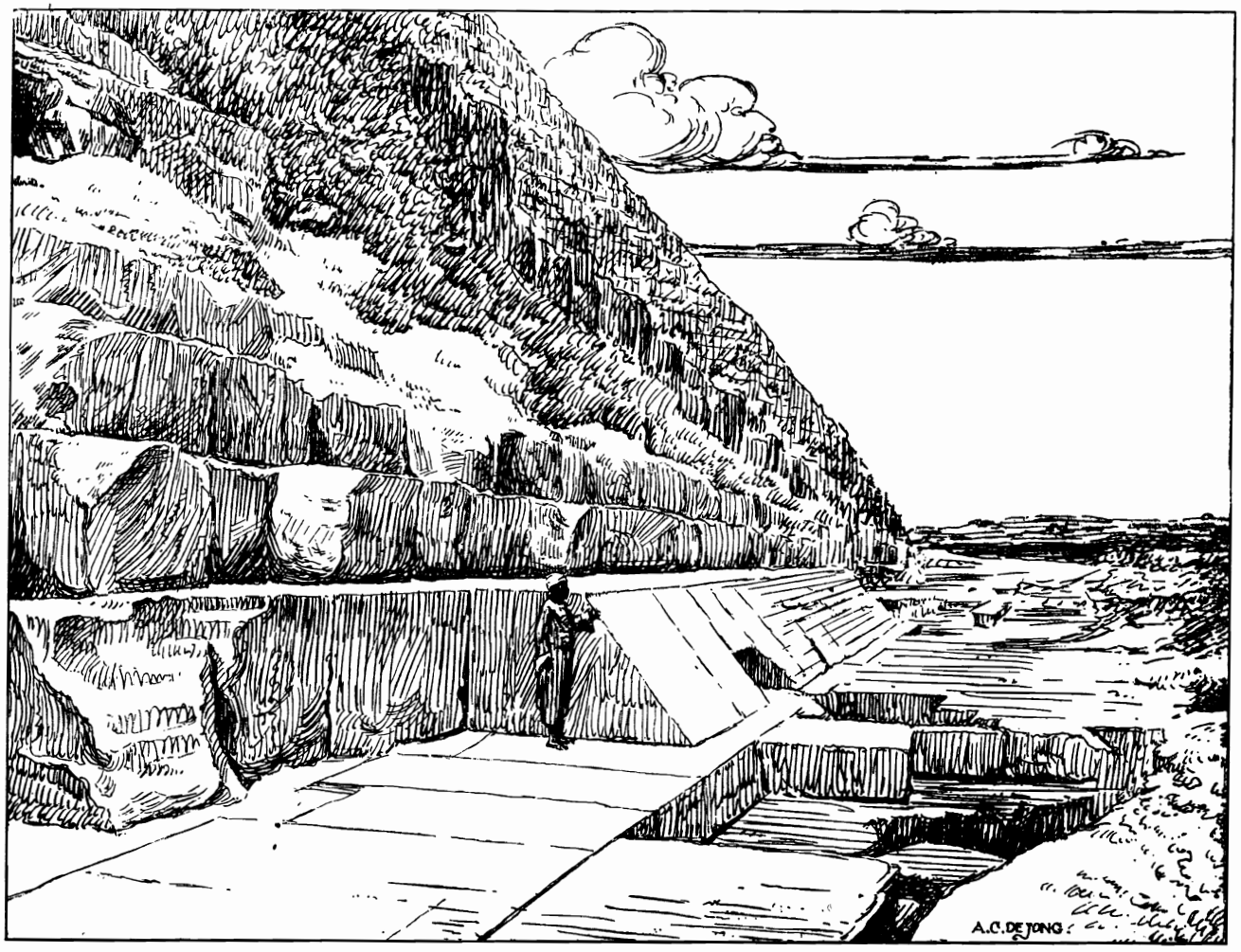
Established that former civilisation more highly skilled than modern in the mathematical basis of the practice of living.

the linear and angular measurements of the Earth and its orbit; defining the annual rates and periods of the cyclical motions of the Earth and its orbit; and defining a system of astronomical chronology that can be the basis of related reference for every period of highly developed stage of civilisation in the world's history.

With these items established as identities, the identities become intentional identities. With the latter established, there will be proved that a former civilisation was more highly skilled in the science of gravitational astronomy—and therefore in the mathematical basis of the mechanical arts and sciences—than modern civilisation. And what will this mean? It will mean that it has taken man thousands of years to discover by experiment what he had originally more precisely by another surer and simpler method. It will mean, in effect, that the whole empirical basis of modern civilisation is a makeshift collection of hypotheses compared with the Natural Law basis of the civilisation of the past.

PLATE XXVI.

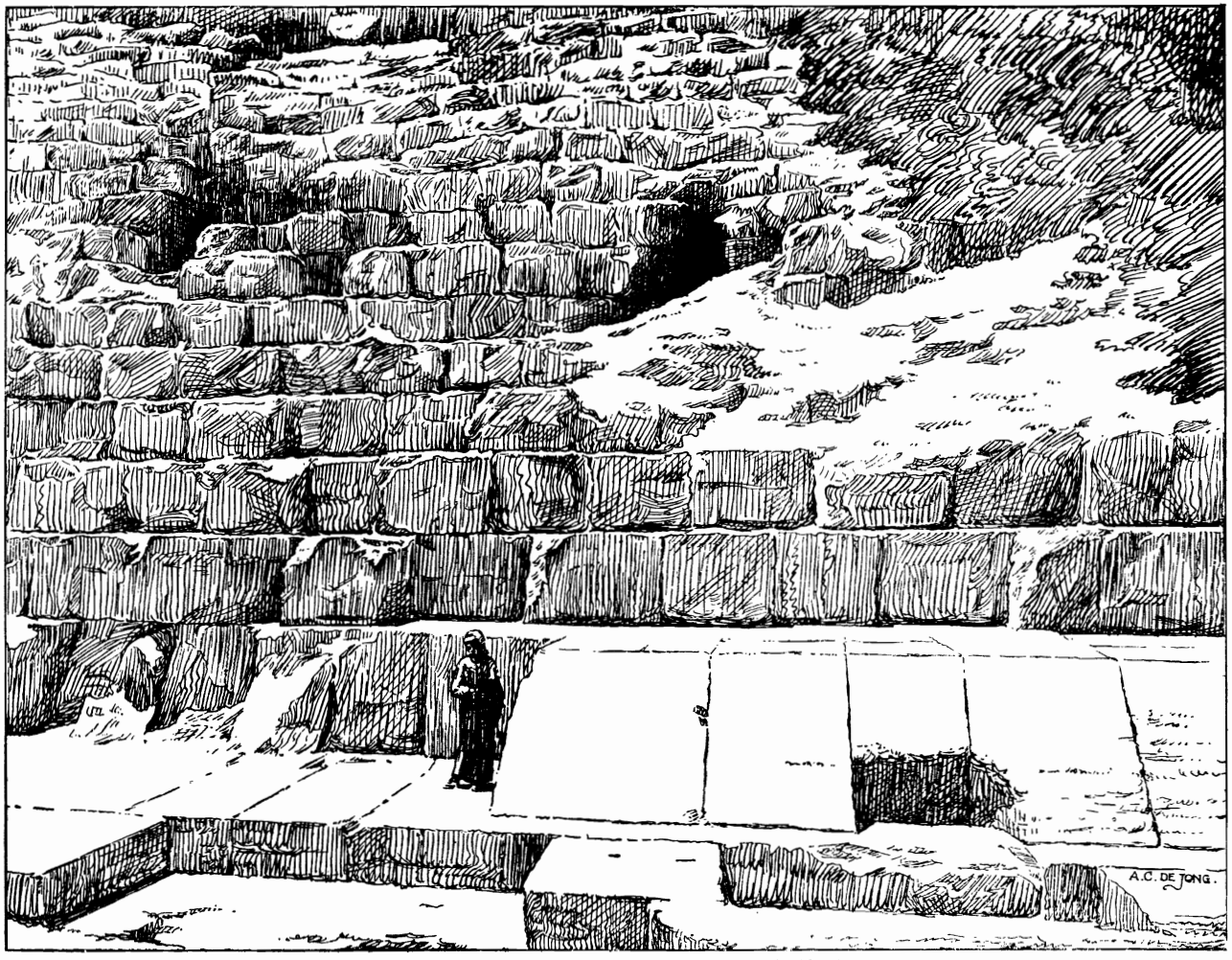
VIEW OF EXISTING NORTH BASE CASING STONES, LOOKING WESTWARDS. FISSURE IN NATURAL ROCK, WHERE PAVING REMOVED, SHOWN IN RIGHT FOREGROUND.



Drawn by Mr. A. C. de Jong from a photograph by Messrs. Edgar.

PLATE XXVII.

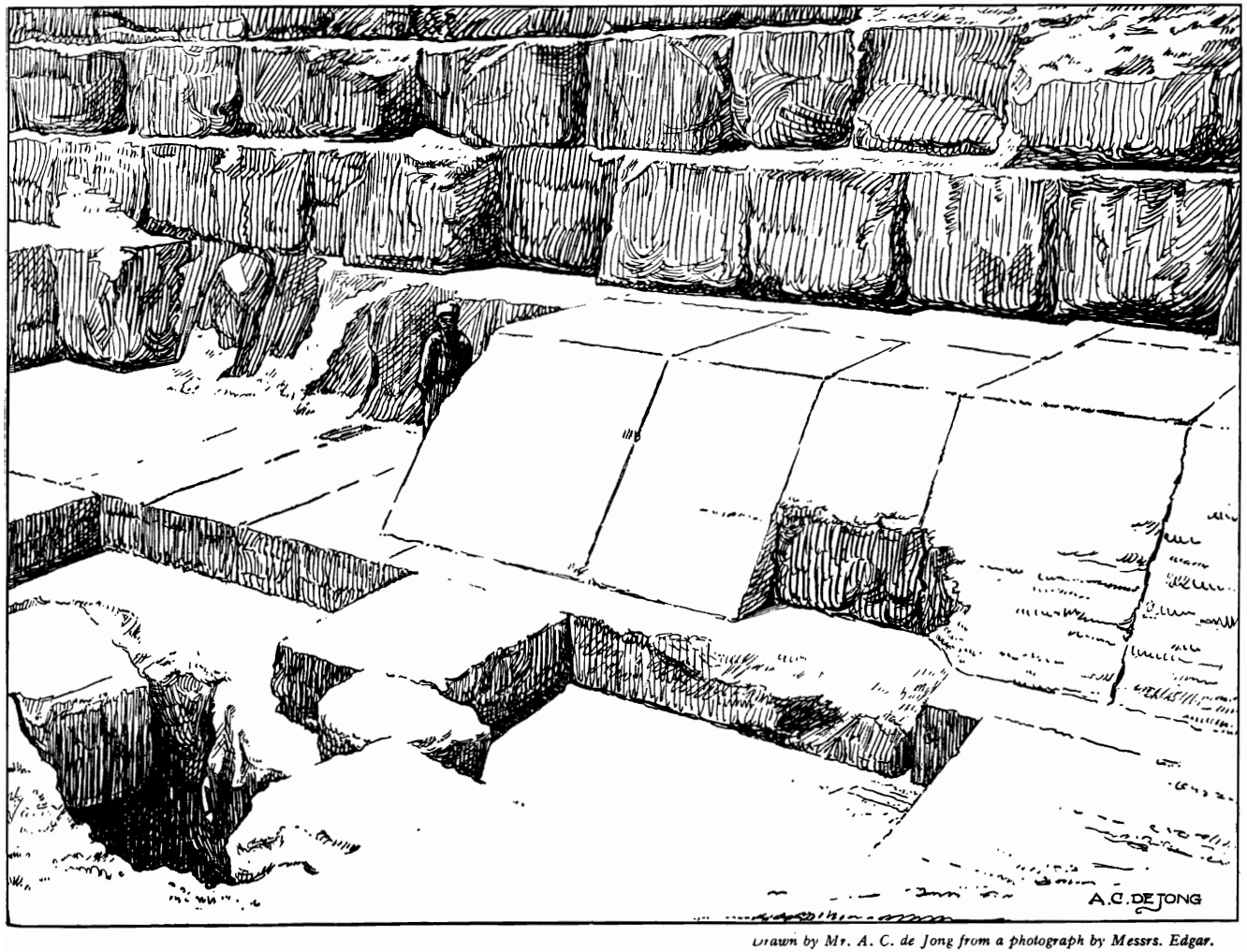
VIEW OF EXISTING NORTH BASE CASING STONES AND PAVEMENT SLABS.
AL MAMOUN'S FORCED ENTRANCE SHOWN ON 7TH COURSE OF MASONRY.



Drawn by Mr. A. C. de Jong from a photograph by Messrs. Edgar.

PLATE XXVIII.

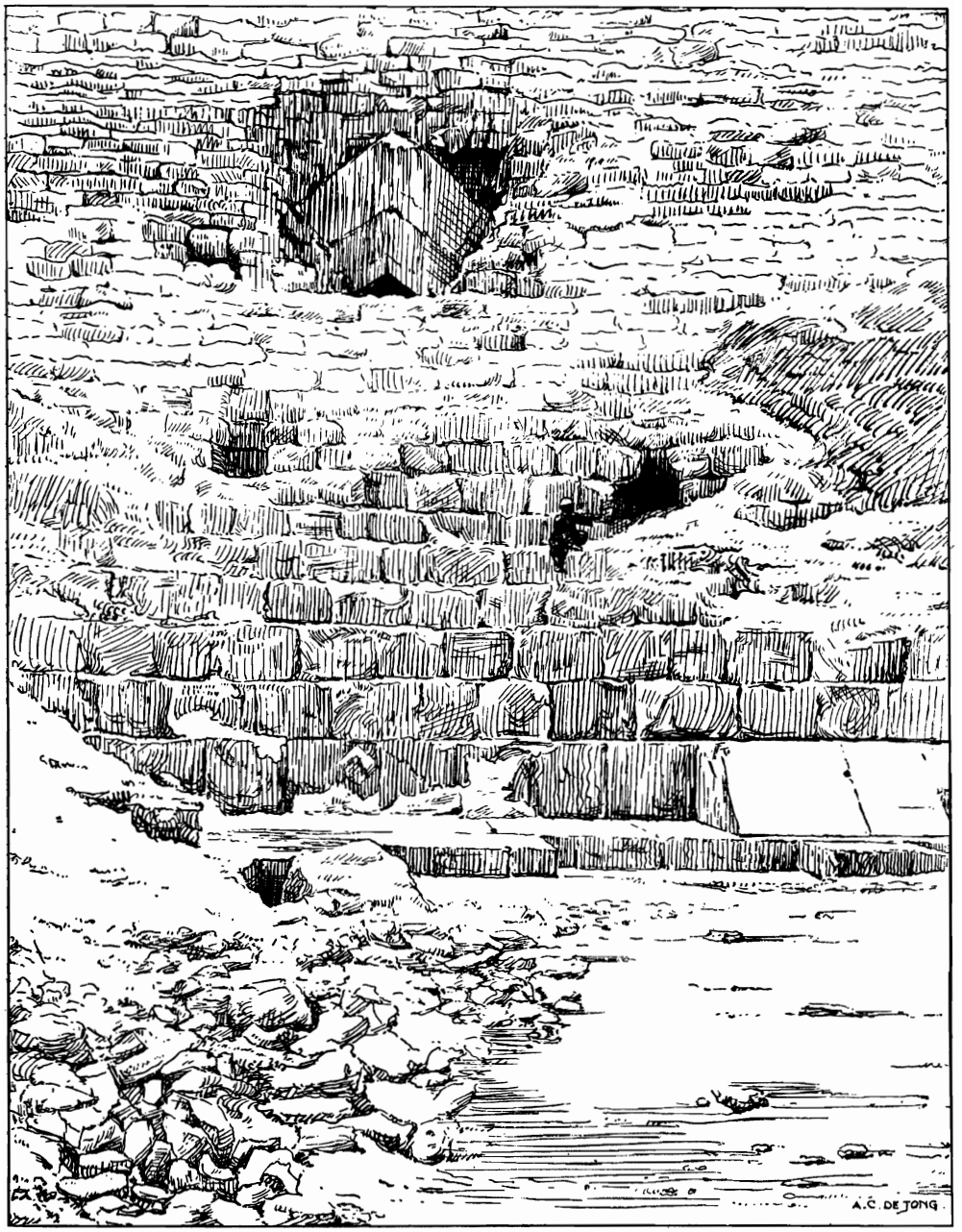
NEAR VIEW OF EXISTING NORTH BASE CASING STONES AND PAVEMENT SLABS, SHOWING FISSURE IN NATURAL ROCK, WHERE PAVING REMOVED, IN LEFT FOREGROUND.



Drawn by Mr. A. C. de Jong from a photograph by Messrs. Edgar.

PLATE XXIX.

VIEW OF EXISTING STATE OF NORTH ESCARPMENT SHOWING EXISTING BASE CASING STONES, AL MAMOUN'S FORCED ENTRANCE—INDICATED BY FIGURE—AND EXISTING STATE OF ENTRANCE TO THE DESCENDING (OR ENTRANCE) PASSAGE.



Drawn by Mr. A. C. de Jong from a photograph by Messrs. Edgar.

Section II.—Pyramid Measures and Details, and Subsidence Distortion.

¶ 170. BASIS FOR COMPARISON OF GEOMETRICAL AND MEASURED DISTANCES.

Geometrical distances must agree with measured distances.

It is futile to discuss any geometrical theory of the Great Pyramid's measurements—internal and external—unless the geometrical distances required by theory agree with the corresponding measured distances. In other words, fact must not be altered to conform to geometrical requirements.

Measured distances must be those taken by responsible scientific measurers.

The actual measurements to be taken as a basis must be those taken by responsible scientific measurers. The taking of linear, as well as angular, measurements is not the simple matter it may appear to those inexperienced in the precise determination of dimensions.

Professor Smyth's angular measurements, and Professor Petrie's linear and survey measurements the best data for an accurate basis of study.

The two best sets of angular and linear measurements of the Great Pyramid are those of Professor C. Piazzi Smyth, late Astronomer Royal for Scotland, and Professor W. M. Flinders Petrie. The former, with his long and varied experience in observational astronomy, possessed the necessary qualifications and apparatus for the taking of reliable angular measurements of a high degree of precision. Professor Petrie, whose archæological survey methods first laid the basis for modern scientific archæological exploration, and whose experience in previous geodetic and other survey work eminently fitted him for the task of surveying the Great Pyramid, has undoubtedly produced the best set of linear measurements to date.

¶ 171. RELATIVE VALUE OF THE TWO SERIES OF MEASUREMENTS AVAILABLE.

Petrie adopts Smyth's precise angular measurements and improves on Smyth's appliances and methods for linear measurements.

Adopting Smyth's angular measurements for the interior details—upon which measurements Petrie could not improve—Petrie took special preliminary precautions in designing and preparing the most reliable measuring appliances obtainable for linear measurements.[1]

Compared with Petrie's steel tape and special chain, 1200 and 1000 inches respectively, and his self-compensating accessory appliances, Smyth's comparatively short measuring rods and accessories were primitive indeed. There are, in consequence, cumulative differences between the two independent sets of linear measurements. Thus Smyth makes the Entrance

[1]These are as described in Petrie's " Pyramids and Temples of Gizeh," pp. 10–15.

Causes of cumulative errors in Smyth's linear measurements.
(1) Piecemeal distances added.
(2) Screw-driver scratches as indications.
(3) Slipping of rods on inclined floor.

(Descending) Passage about 3 inches shorter than Petrie's measurement for this. Petrie accounts for the differences as follows :—

" (1) By his (Smyth's) being all piecemeal measures added together ;
" (2) By the rude method of making scratches with a screw-driver to mark the lengths of the rod on the stone (' Life and Work,' II, 46) ; and
" (3) By there being ' always a certain amount of risk as to the measuring rod slipping on the inclined floor ' (' Life and Work,' II, 35).
" All these errors would make the reading of the length shorter than it should be."

Direction of error.

Above applies to interior measurements.

Smyth never surveyed Pyramid's exterior.

It must be understood, of course, that these remarks concerning the relative value of the two series of linear measurements apply to the interior of the Pyramid only. Professor Smyth never surveyed the Pyramid's exterior. In fact, he never knew the precise or approximate measured relations of the Pyramid's base—unless in theory—until Professor Petrie's survey had been published, almost 20 years after Smyth's work at the Pyramid.

Existing interior indications best evidence for study of external movements.

Why the interior measurements of the Pyramid are mentioned at this stage is for the reason that it is from the existing condition of the interior we have the clearest evidence concerning the cause and direction of the movements that affected the exterior of the Pyramid (¶¶ 141–147).

¶ 172. THE CRITICAL VALUE OF PETRIE'S MEASUREMENTS.

Petrie benefited from Smyth's experience.

The fact of moment is that Petrie's appliances were prepared and his linear measurements taken with a critical knowledge of the defects in Smyth's appliances for linear measurements, and of the inaccuracies liable to occur in the application of Smyth's method of measurement. This is not to say that had Petrie been in Smyth's place as original reliable measurer, Petrie's apparatus and methods would have been any better than those Smyth adopted.

Petrie's appliances and methods designed as improvements on Smyth's appliances and methods.

The truly scientific worker always endeavours to improve upon the apparatus and methods of his predecessors, and to benefit by their experience. Smyth published an account of the defects in his appliances and method of measurement. Petrie, accordingly, designed his appliances and formulated his system of measurement to eliminate the defects revealed by Smyth's experience.

Petrie's Pyramid survey and linear measurements the best to date.

Apart, then, from any question of preference a possibly biassed judgment might accord to actual measurements most nearly agreeing with geometrical measurements, Petrie's statement of his linear measurements must receive preference as the most reliable statement of the Pyramid's measures as they now exist. Against this we must place the fact that Petrie's measurements clearly were taken to disprove Smyth's theories. Were this not a fact, Petrie could scarcely have failed to see that his own survey and set of measurements, and his comprehensive classification of ancient metrology, contained more distances of geometrical significance than Smyth, or any of his innumerable contemporaries and followers, ever claimed or showed in measurement. This is true both in regard to the Pyramid's external measures and internal measures.

His data prove more science in the Pyramid than ever Smyth claimed.

¶ 173. HOSTILE DATA CONFIRMING INDUCTION.

The influence of biassed opinion in the two series of data.

The possibly small bias evidenced in Petrie's measurements is more than balanced by another fact to be admitted, viz. that Smyth's measurements were taken with the hope of finding confirmation of his own and John Taylor's theories. The influencing bias—unwitting, but psychologically unavoidable—is evidenced in several outstanding cases in the statements of both measurers, Smyth and Petrie; more by unwittingly biassed judgment authorising the selection of averages, than in judgment controlling the taking of any particular measurement.

Bias psychologically inseparable from preconceived belief.

But does not detract from the value of data collected under bias, and hostile to a theory, verifying that theory.

The exponent of a theory, or the holder of a preconceived belief, must always be considered, from any critical point of view—whether friendly or hostile—as potentially and psychologically, though possibly unwittingly, biassed in favour of evidence that accords with his theory or preconceived belief. This, it must be granted, is a fair statement of the mentality that should be adopted to consider logically any statement concerning the results of inductive analysis. It is not a statement, however, that can be applied in the particular instance of Petrie's data—hostile to Smyth's theories—confirming the latter in a manner never imagined by Smyth or any of his followers.

Sir John Herschel's statement concerning such cases.

Of such cases, Sir John Herschel[1] stated :—

> "The surest and best characteristic of a well-founded and extensive induction is, when verifications of it spring up, as it were, spontaneously into notice from quarters where they might be least expected, or from among instances of that very kind which were at first considered hostile. Evidence of this kind is irresistible, and compels assent with a weight that scarcely any other possesses."

¶ 174. BIASSED OPINION DELAYING PROGRESS OF DISCOVERY.

Examples of above:—

Egyptian Common Cubit cited by Petrie as opposed to Smyth's Pyramid Inch.

Smyth ridicules value of Egyptian Common Cubit.

Yet Egyptian Common Cubit of Petrie's value verifies Pyramid Inch of Smyth's value.

One good instance of the truth of Herschel's statement is seen in the case of the origin of the Common Egyptian Cubit from the Primitive Polar Diameter Inch and the Year Circle geometry. Petrie was hostile to the latter, and Smyth hostile to the former. Yet the admirable classifications of Petrie's inductive metrology have shown us that the Common Egyptian Cubit is a simple function of Smyth's Pyramid Inch, and that the latter is truly a Polar Diameter Inch.

Smyth's original theory—without precise data—correct on general lines, but wrong in application to detail.

Again, with no precise measurement of the Pyramid's base to guide him, Smyth, from a few remotely secondary external and internal details of the Pyramid's construction, inferred that the circuit of the Pyramid base consisted of 36,524.2 Polar Diameter inches, and that the Pyramid's height was the radius of a circle of the latter circumference. Smyth even supposed originally that the pavement upon which the Pyramid was built formed part of the casing, and that the Pyramid base level was at the bottom of the pavement blocks.

[1] "On the Study of Natural Philosophy" (1830), p. 170.

Petrie's survey proving Smyth's application wrong, Petrie failed to see the truly obvious application, and Smyth resorted to a revised application more impossible than his original.

The latter revision strengthened Petrie's case—as being the more logical.

Result:—20 years' delay.

It was not until Petrie—nearly 20 years after Smyth's work at the Pyramid—published his results that Smyth indicated, in his later editions, the casing blocks sitting on the pavement. Petrie, on the other hand, whilst observing the hollowing-in of the core, failed to see that the purpose of this was to provide the backing surface for a similar hollowing-in of the casing. This oversight delayed the presentation of the Pyramid's message for a further period of 20 years. For Petrie declared that his survey failed to confirm Smyth's theory in any single detail, except the casing angle of slope. This declaration was given additional weight by Smyth readjusting his theory to suit what he supposed Petrie's survey to indicate. Smyth's readjustment required the circuit of 36,524.2 to be at a level where it could neither be indicated nor measured, *i.e.* in the natural rock at the level defined by him as the mean socket floor level.

¶ 175. SMYTH'S THEORY CONCERNING PYRAMID'S PURPOSE CORRECT.

Smyth's mean socket floor level for base of Pyramid has no structural definition.

Investigation showed the absurdity of this readjustment. For, apart entirely from the obviously untenable nature of the readjusted theory, neither the mean socket floor level, nor yet the lowest socket floor level, gave the true level for the Pyramid base circuit, unless by altering the angle of slope of the Pyramid. As this further readjustment destroyed all the other essentials of the theory, it was reasonably assumed in sequence by accredited authorities—

Led to authorities condemning Smyth's theory of the Pyramid's purpose.

(1) That Petrie's survey was correct; and hence
(2) That Smyth's theory was wrong.

They gave not a moment's consideration to the other possible and reasonable sequence—

(1) That Petrie's survey, being correct, might show
(2) That Smyth's theory was correct on premises other than Smyth's, and on premises other than Petrie inferred from his reliable survey data.

The facts are:—Petrie's survey correct, Petrie's application of survey incomplete, Smyth's theory concerning Pyramid's purpose correct, and Smyth's theories concerning structural identification of his theoretical principles incorrect.

We now realise that the sequence is as follows:—

(1) That Petrie's survey is correct; and
(2) That, in consequence, Smyth's theory concerning the purpose of the Pyramid is correct.

This is precisely the kind of verification that Sir John Herschel defined as being "the surest and best characteristic of a well-founded and extensive induction."

¶ 176. EFFECT OF SUBSIDENCE ON PYRAMID PASSAGES.

Petrie proves effect of subsidence in King's Chamber, but ignores related effect in Passages, proved by his measurements.

One other feature essential in any analytical investigation of the Great Pyramid's measures, but that has never been properly discussed in this connection, is the question of subsidence. It is true that Professor Petrie specially discusses the effects of subsidence in the King's Chamber; but he

has passed over in silence the necessarily related effect of the same movement upon the angle of inclination of the Passages. He states that the angle of inclination for the Ascending Passage is slightly flatter than, and for the Descending Passage slightly steeper than, Smyth's theoretical angle for these Passages. This, however, is precisely the condition in these Passages that would follow from subsidence movement.

Rate of steepening and flattening of slopes of Passages follow known law of subsidence.

Smyth's theoretical angle for both passages is 26° 18′ 9″.63 with the horizontal. Subsidence below the centre of the Pyramid's mass would increase the angle of the Descending Passage and decrease the angle of the Ascending Passage. Accordingly we find that the mean angle of the built portion of the Descending Passage is 26° 26′ 43″ (Smyth and Petrie), of the first Ascending Passage, 26° 2′ 30″ (Petrie), and of the Grand Gallery, 26° 17′ 37″ (Smyth and Petrie).

Proves that Smyth's theoretical Passage angle of slope was angle of Descending and Ascending Passages.

The distortion of the King's Chamber proves that subsidence has taken place. The fact that subsidence has taken place below the Pyramid proves that the angle of the Descending Passage has steepened, and that the angle of the Ascending Passage has flattened. The massive and rigid construction of the Grand Gallery has been able largely to resist relative movement between its various parts. It has subsided almost bodily, thus almost exactly retaining its original angle of slope, being now only 33 seconds of angle flatter than the theoretical angle of 26° 18′ 10″.

That 26° 18′ 10″ was the original angle of slope is clearly shown by Petrie's detailed measurements.

Original angle of slope, 26° 18′ 10″.

¶ 177. SMYTH'S THEORETICAL ANGLE CONFIRMED.

At Petrie's floor distance of 990 B″ down the Descending Passage from the original Entrance Doorway, the Passage suddenly commences to increase its dip. Between the latter point and Petrie's floor distance 1505 B″, near which—within an inch or two—the Descending Passage intersects the Pyramid base level, the angle of slope of the Passage floor line is 26° 34′ 0″. This is obtained from Petrie's offsets from his theodolite altitude of 26° 31′ 23″, stated as the mean angle for the whole Descending Passage length to its termination deep in the natural rock.[1]

Descending Passage length 515 inches back from base, subsided angle of slope, 26°.

The effect of subsidence movement below the Pyramid's base level on the Descending Passage immediately above the base level is therefore 26° 34′ 0″, less the original angle of slope. Presuming the latter to be 26° 18′ 10″, Smyth's theoretical angle—we obtain 15′ 50″ as the amount by which the Descending Passage, immediately above the base level, has been steepened by subsidence in the natural rock below the base level. Now this amount is also the amount by which the portion of the Ascending Passage nearest the natural rock has been flattened. This portion of the Ascending Passage should therefore be 26° 18′ 10″, less 15′ 50″=26° 2′ 20″, whereas the mean angle of slope of the 1st Ascending Passage is 26° 2′ 30″.[2]

1st Ascending Passage mean subsided angle of slope, 26° 2′ 30″.

Restoration to a common angle for both gives 26° 18′ 15″.

Theoretical 26° 18′ 10″.

[1] "Pyramids and Temples of Gizeh," p. 58.

[2] Ibid., p. 61.

¶ 178. SIGNIFICANCE OF EXISTING CENTRIC POSITION OF STEP AND QUEEN'S CHAMBER.

Existing Queen's Chamber and Great Step both lie in East to West vertical plane through centre of base square.

A feature of original design and construction.

Another detail, however, confirms the latter conclusion. Petrie's interior linear and angular measurements show that the existing centre of the Queen's Chamber and the existing termination of the Grand Gallery floor at the Great Step both lie in the central vertical East to West plane passing through the centre of the Pyramid's square base area. This coincidence is obviously intentional. Petrie accepts it as such, and therefore as a feature of the original design and construction.

This feature persisting proves that centre of subsidence is not far from centre of Pyramid's base.

The significance attaching to this feature still existing, is that it supplies an important indication as to the approximate location of the centre of subsidence. It indicates that this centre was not so sufficiently remote from the Pyramid's base centre as to produce appreciable horizontal North to South displacement of the Great Step and of the centre of the Queen's Chamber. As a result, near these points, the tangents to the curve of the subsided core courses of the Pyramid would not be far from the horizontal, unless where locally buckled by thrusting. As a corollary of this, the subsided Grand Gallery floor near the Great Step should still retain its original angle of slope of 26° 18′ 9″.63. Professor Petrie's offsets to the Grand Gallery floor from his altitude line in the last 213½ inches towards the Great Step prove this to be the case.[1] The existing vertical distance between the foot of the Great Step at the South end of the Grand Gallery and the floor level at the North end of the Grand Gallery is 0.54 B″ less than for the original angle of 26° 18′ 9″.63.

Latter fact explains retention by Grand Gallery floor of its original angle of slope in its terminal length of 213½ inches, 26° 18′ 10″.

¶ 179. SIGNIFICANT EFFECT OF RESTORATION OF ORIGINAL PASSAGE ANGLE.

Original angle of slope of Passages verified.

Calculation shows that with Petrie's Passage lengths along original Passage slope, Great Step and Queen's Chamber remain in the same centric position.

The still existing centrally located position of the Great Step and Queen's Chamber, however, supplies us with a more certain basis for testing Smyth's theoretical angle for the Passages than any of the above lines of inquiry. This is, that if the location defined is the original location—and there is no disagreement on this question—and if the angle of slope of the Passages was originally 26° 18′ 9″.63, then with Petrie's existing Passage lengths from the existing Entrance Doorway on the North face to the junction of the Passages, and from the junction to the Great Step, both applied along the inferred original angle of 26° 18′ 9″.63, the Great Step and the centre of the Queen's Chamber should still be in the same central location. Calculation along the lines defined agrees precisely with the conditions inferred.

Petrie's definition of existing centric position of Great Step and Queen's Chamber.

Thus Petrie states that his survey data, Passage measurements and angles define—

(1) Existing face of Great Step as 0.4 B″ South of existing centre of Pyramid, with probable error of ±0.9 B″; and

[1] "Pyramids and Temples of Gizeh," p. 71.

(2) Existing centre of Queen's Chamber as 0.3 B″ North of existing centre of Pyramid, with probable error of ±0.8 B″.

Petrie accepts from these that the central location was intentional.

Adopting the centric position of the Great Step, Petrie's Passage floor distances, the constant angle of Passage slope of 28° 18′ 9″.63, and Petrie's Entrance Doorway on Pyramid face at 668.28 B″±0.1 above pavement base, we obtain as follows :—

Petrie's Passage distances on original angle of slope give the same centric position.

Horizontal Distance, Great Step to North End, Grand Gallery	=1627.5331 B″.
Horizontal Distance, North End, Grand Gallery to Junction of Passages	=1386.6529 B″.
Horizontal Distance, Junction of Passages to Petrie's Entrance Doorway	= 995.6504 B″.
	4009.8364 B″.
Horizontal Distance, Petrie's Entrance Doorway to Petrie's existing North Casing Base	= 524.1 ±0.3 B″.
Centre of Pyramid to existing North Casing Base ..	=4533.9364±0.3 B″.
The same distance on Plate XX=distance O to CD ..	=4533.7100
The difference lies within Petrie's range of possible error	0.2264±0.3 B″.

¶ 180. PASSAGE DISTANCES PROVE HORIZONTAL INWARD MOVEMENT OF BASE CENTRES.

In the above series of additions the existing North casing base point at 524.1±0.3 B″ horizontally from Petrie's Entrance Doorway was taken without any reference to the question of the angle of the Pyramid's face slope. This has been shown to have been originally exactly 51° 51′ 14″.3.

Petrie has proved conclusively that the floor of the Entrance Doorway certainly commenced at 668.28±0.1 B″ above the Pyramid's Pavement Base. The level and depth of the 19th course of masonry determine that the Entrance Doorway emerged with its roof line at the top of the course and its floor line at the bottom of the course. Near the Entrance, the existing bottom level of this course is 668.28±0.1 B″, as Petrie has shown. Nothing can be more certain than that this gives the original floor level of the Passage at the Entrance on the face slope.

Original Entrance Doorway emerged on Pyramid face in depth of the 19th masonry course.

We therefore have two certain facts to guide us. The Entrance floor on face slope was 668.28±0.1 B″ above the Pavement, and the angle of slope was 51° 51′ 14″.3. From these we find that the original horizontal distance from casing base to Entrance floor was 524.91 B″±0.1, or 0.8 B″

Entrance floor originally 524.8 B″ horizontally from central edge of North casing base.

longer than the existing indications tend to show. Adding the latter in the series of horizontal passage distances of ¶ 179 we obtain—

	Plate XXX Original.	Plate XXX Petrie's existing.
Horizontal distance, Great Step to Entrance Floor	=4009.84 B″	4010.91 B″±0.6
Horizontal distance, Entrance Floor to original North Casing Base.. ..	= 524.91 B″±0.1	524.10 B″±0.3
Horizontal distance, Great Step to North Casing Base	=4534.75 B″±0.1	4535.01 B″±0.9
Deduct, Plate XX, existing distance O to DC	=4333.71	

Original horizontal length from Entrance to Step proves existing North Base has moved 1 inch inwards,

and

Extent to which centre of North Casing Base has been drawn in by subsidence towards centre of Pyramid. } 1.04 B″±0.1.

That there was a separate Northwards relative horizontal movement between core masonry courses, increasing in extent from nothing at the base course to a maximum at the top course.

In ¶ 147 this was independently obtained as 1.0 inch average for each casing face, or a total drawing together of the centre of the North casing base and the centre of the South casing base of 2.1 inches. (Refer also ¶¶ 142-145.) The existing details and measurements discussed above show further that, in addition to this general movement, there was a relative horizontal movement between the masonry courses of the Pyramid core; that this movement became in extent cumulatively greater for higher courses; and that the general direction of the movement of successive courses was towards the North side, steepening the Pyramid's face slope from its original 51° 51′ 14″.3 to 51° 53′ 20″ between the existing base and the existing 19th masonry course. The nature of the relative movement indicates that the angle of North face slope should become steeper for higher courses.

¶ 181. INDICATIONS OF FURTHER MOVEMENT INWARDS OF SOUTH BASE CENTRE.

Petrie's surveyed point on South casing base edge.

Lies 113.6 B″ external to maximum hollowed-in base strip.

Indicates a further movement inwards of central area of Pyramid South base to extent of 1.11 B″.

Total inward movement of centre of South base now 2.17 B″.

One feature not entirely dealt with concerns the South base point G on Plate XX. G is the point located and surveyed in by Petrie. In ¶ 147—and prior to the geometrical definition of the central width of maximum hollowing-in—this point was considered as lying on the base edge of this central area, *i.e.* on the line D_1H_1 of Fig. B, Plate XXV. Actually, by comparing Plate XX, for point G at 1028.7 B″ from centre of base, with Plate XXV, for Point D_1 on Fig. B at 914.1 B″ from centre of base, we find that Petrie's South base survey point (G on Plate XX) lies on the line D_1A of Plate XXV, Fig. B, and 113.6 B″ from D_1 towards A. In this position on the geometrical Pyramid base, point G (Plate XX) should be 1.11 P″ further South than the maximum hollowed-in base line D_1H_1 (Plate XXV). Its distance South from the base centre should therefore be 4535.85 B″, whereas the corresponding existing distance is 4533.69 B″, or 2.17 B″ less than the existing distance.

Now we have already seen that the centre of the South base has moved inwards, owing to subsidence movement, at least 1 inch. The Passage data of ¶ 180 have confirmed the data of ¶ 147 by indicating that the North base has moved inwards 1.04 B″ ±0.1. The total movement of North base centre and South base centre inwards was estimated in ¶ 147 as 2.1 B″. To this we must now add an additional 1.11 inches for South base movement extra to that estimated. This gives the total movement inwards between the centres of opposite base sides as 3.21 inches—2.17 inches inwards on South side, and 1.04 inches inwards on North side. The movement, as defined, is confirmed by two features of the Pyramid's exterior.

Movement confirmed by two other external features of the Pyramid.

¶ 182. THE MOVEMENT OF THE SOCKETS, AND THE DISTORTION OF THE CORE ESCARPMENTS.

One of the features referred to has already been considered in ¶¶ 145 and 180, and the other at the end of ¶ 180. The former showed that the side of the *true* square defining the half-diagonal OM (Plate XX) required to be 4570.55 B″, whereas the existing East side of this square is 4567.02 B″, or 3.53 B″ less than the true square defining the half-diagonal. This indicates a movement of the South-East socket 3.53 B″ towards the North. Professor Petrie's data on his Plate X presuppose correction for this movement without drawing attention to the actuality of the movement, since his survey data on pages 38, 39, and 206 do not agree with his data on his Plate X.

Distortion of existing socket distances defining base diagonals indicates necessary extent of natural rock movement to effect the above Pyramid base movement.

A ground movement is necessarily greater than a compactly massive building movement effected by it. Hence the Pyramid masonry base movement is less than the South-East socket movement.

The second feature referred to is the distortion of the Pyramid's core escarpments. The North core escarpment up the centre of the North face is steeper than the South core escarpment up the centre of the South face (confirming ¶ 181). The former, from the base to the existing top, is 51° 54′ 24″, whereas the latter is 51° 51′ 13″, or within 1″ of the true angle of slope of the casing. This difference of angle would be the exact effect of the return ground wave, or " echo " wave of the earth tremor of a subsidence that had produced a steeper dip in the Pyramid's courses inwards from the South side than inwards from the North side.

Direction of distortion of core masonry confirms nature of Pyramid base movement.

Indicates nature of base subsidence and Earth tremor effect producing the distortions and movements.

¶ 183. RELATION BETWEEN PASSAGE SUBSIDENCE AND SUBSIDENCE OF COURSES.

The general form of the subsidence effects on the Great Pyramid can be obtained from a study of the subsidence effects in the Passages and Chambers. We have seen that the original angle of slope of the Descending and Ascending Passages was 26° 18′ 9″.63. Correcting all Passage points to their original positions at this angle of inclination, commencing from the Entrance inwards, will give us the extent of subsidence at all such Passage points.

Comparison of points of the Passages at original angle, and the corresponding points of the existing Passages gives subsidence at all such points.

Thus we find that the levels of the original and existing principal floor points of the Passages—and their extent of subsidence—are as follows :—

Comparative statement for principal points of Passages.

	Original.	Existing.	Extent of Subsidence.
	B″.	B″.	B″.
Floor junction of Descending and Ascending Passages	176.1	172.9 ±.2	3.2
Floor joint, North End, Grand Gallery	861.5	852.6 ±.3	8.9
Foot of Great Step, Grand Gallery	1666.0	1656.5 ±.5	9.5
Top of Great Step,[1] Grand Gallery (35.87 B″)	1701.87	1692.36±.5	9.5

Plate XXX gives a graphically illustrated comparative statement of all the existing and original dimensions of the Passages, together with a statement of the cumulative subsidence in the Passages.

Above comparative results in accordance with the law of structural subsidence.

Maximum subsidence in central area of base course, minimum at apex and base square edges.

Ascending cumulative loss of subsidence in any vertical due to "flat-arching" of courses.

The above tabulation shows, in accordance with the laws of central mass subsidence, that the subsidence effects follow, progressively increasing, from the North base inwards towards the centre. This progressive increase continues beyond the centre into the King's Chamber, where the lowest floor point is 2.4 B″ lower than the top of the Great Step. The total extent of subsidence, therefore, at the level of the King's Chamber and at the South-East corner of the King's Chamber is 9.5 B″+2.4 B″=11.9 B″. The subsidence at the Pyramid's base vertically below this is necessarily greater than this amount, owing to the cumulative loss of subsidence in ascending order of courses, for points of courses on the same vertical. This cumulative loss of subsidence holds for every vertical line passing through the courses, and is due to the well-known structural effect of "flat-arching."

¶ 184. BASIS OF SUBSIDENCE DIAGRAMS.

At lower end Descending Passage, subsidence, 14 B″; entering into natural rock, 4 B″.

Subsidence of points in natural rock, length of Passage gives settlement of corresponding points on base courses vertically above.

Proceeding, then, in the same way for the Descending Passage, we find that its lower sloping end in the natural rock—about 303 B″ horizontally North from the Pyramid's base centre—has subsided 20 B″, and at its entrance into the natural rock has subsided 4 B″. Proceeding thus for all intermediate points in this Passage we obtain the cumulative extent of subsidence from the North face inwards towards the centre. This gives, in the natural rock, the extent of settlement of the base courses at points vertically above the

[1]It is as well to state here that Professor Petrie has an unfortunate error in his calculations for the level of the Step, and, in consequence, for every point beyond that. All his other existing levels for the Passages have been correctly reduced from his data. In this case, however, he has stated the End of the Gallery as 2.39 B″ higher than his own data prove it to be. This can be shown from a simple statement of the facts. His horizontal distance for the Grand Gallery agrees with his sloping distance and angle of slope for the Gallery, but does not agree with his vertical rise for the Gallery floor. The latter gives a steeper angle of slope than the original angle of 26° 18′ 9″.63, whereas Petrie's stated existing angle is less than this.

His offsets from his theodolite altitude line determine that the foot of the Great Step is 0.54 B″ vertically lower than the same for an altitude of 26° 18′ 9″.63. As the rise from the commencement of the Gallery to the foot of Step with the latter angle is 804.47 B″, the existing rise is 803.93 B″, whereas Petrie's rise is 2.39 B″ higher. Refer also Notes on Plate XXX.

Passage points taken. The general rate of increase of subsidence again indicates that the maximum extent of subsidence is nearer the South base side than the North base side, thus confirming the indication of the King's Chamber in ¶ 183, and confirming the inference derived in ¶¶ 181 and 182, as to the additional movement of the South base side inwards at its centre towards the centre of the Pyramid's base area.

Indicates maximum subsidence nearer South than North base side.

The extent of subsidence thus obtained at all observed points in the Descending and Ascending Passages, and in the Antechamber and King's Chamber, enables us to plot a diagram of subsidence. To make this diagram of use in studying the related movements, it is necessary to magnify the subsidence movement. We can produce a true-to-scale representation of subsidence by drawing the Pyramid and its Passages to a certain scale, and then drawing all existing variations horizontally and vertically from their original positions as ten times their true extent. All that this amounts to is that we are imagining the subsidence effects to be ten times greater than they actually are.

Measured variations in subsidence in all Passages form basis for diagrams of general Pyramid subsidence.

Subsidence in diagrams shown as ten times actual subsidence.

Drawn in this manner, Plate XXXI represents the subsidence of all the Pyramid's courses and Passages, as indicated by the existing variations of the floor or axis levels of the Passages. Similarly Plate XXXV gives the subsidence effects in the King's Chamber and Antechamber, and in their connecting Passages.

General diagrams of Pyramid subsidence.

Diagram of King's Chamber and Antechamber subsidence.

¶ 185. PYRAMID COURSES AND HORIZONTAL COURSES OF CHAMBERS.

Study of the precisely determined relative amounts of subsidence in the Passages and Chambers in relation to the two subsidence diagrams—Plates XXXI and XXXVa—establishes the following identities between horizontal passage and chamber masonry courses on the one hand, and the horizontal courses of the Pyramid core masonry on the other hand :—

	Existing Lowest Level.	Subsidence.	Originally.	Existing Levels of Courses on Pyramid Core Face.		Top of Course Nod. Plate XX.	
				S.W.	N.E.		
	B″.	B″.	B″.	B″.	B″.		
Ceiling level of King's Chamber	1920.7	11.8	1932.5	1931.7	1931.7	59th	**King's Chamber ceiling top of 59th course.**
Ceiling level of Antechamber ..	1840.3	11.2	1851.5	1851.5	1851.9	56th	**Antechamber ceiling top of 56th course.**
Base of walls of King's Chamber	1685.4	11.8	1697.2	1697.7	1697.6	50th	**King's Chamber and Antechamber wall base top of 50th course.**
Base of walls of Antechamber	1686.0	11.2					
Top of North and South walls, and course of East and West walls, Queen's Chamber	1018.9	12.6	1031.5	1030.9	1031.0	30th	**Top of North and South walls and course level of East and West walls in Queen's Chamber top of 30th course.**

As to the variations in depths of existing masonry courses, Petrie, in his Plate VIII, gives these as follows:—

For 59th course, 1 inch variation; 56th course, 0.4 inch;
50th course, 0.2 inch; 30th course, 1.5 inch.

Latter level at height giving length of side of ¼-Aroura square = 1030.33 P″, and ceiling of horizontal Passage to Queen's Chamber at level of ceiling of 1st Ascending Passage entrance to Grand Gallery.

The above statement of levels shows that the level of the original top of the North and South walls of the Queen's Chamber was 1030.33 P″=1031.46 B″, the length of side of the quarter-*aroura* square. Since the height of the North and South walls is 184.4 B″=184.2 P″, the original level of the Chamber floor was 846.130 P″=847.06 B″. The existing level being 834.4 B″, the extent of subsidence in the Queen's Chamber is 12.66 B″. This amount of subsidence here agrees with the cumulative rate of increase of subsidence effect on the courses from the Great Step vertically downwards to the centre of the base area. The same restoration gives the original level of the ceiling of the horizontal Passage to the Queen's Chamber coincident with the original level of the ceiling of the 1st Ascending Passage at the Entrance to the Grand Gallery, *i.e.* at 914.4 B″.

¶ 186. PYRAMID'S CONSTRUCTIONAL DETAILS DESIGNED TO MEET SUBSIDENCE EFFECTS.

Rock fissures indicate cause and nature of subsidence.

Existed prior to construction.

Plate XXXI shows clearly the cause and nature of the subsidence. The cause is seen in the several fissures in the natural rock portion of the Descending Passage. These had existed when the Passage was cut in the natural rock. Two of them have been built up with blocks by the original builders.

Fissures due to collapse of a subterranean cavern deep in limestone forming the Nile Valley.

Designer of Pyramid's constructional details aware of this, and took constructional measures to meet contingencies likely to arise from conditions noted.

These fissures are the evidence of the collapse of a subterranean cavern deep in the limestone forming the Nile Valley, which contains many examples of this cause of subsidence. This subsidence, as we saw, occurred prior to the building of the Pyramid. Indeed, many special details of the Pyramid's construction indicate that the designer of the constructional details was aware of the subsidence, and took special constructional measures to meet its effects. This is evident particularly in the construction of the masonry chambers and in the construction of the Grand Gallery. In fact, the Great Pyramid is as perfectly designed to meet, and adjust itself to, the conditions of subsidence as it well could be; more perfectly designed for its substrata conditions than St. Paul's Cathedral, for example, was designed to meet the conditions of its substrata.

The precarious stability of fissured foundation strata.

Effect of central mass of Pyramid on same.

Where limestone fissures occur there is instability, particularly under added burden to the strata in which they occur. The designer of the Pyramid's constructional details foresaw the possibility of the existing precarious stability of the fissured strata being disturbed by the superimposed central mass of the Pyramid's masonry. That his details, devised to meet the expected vertical movement, were effective is proved by the fact (shown by ¶ 180) that the Passage lengths, in spite of subsidence, have remained unaltered.

¶ 187. THE CONSTRUCTIONAL PURPOSE OF THE TERRACED ROCK CORE.

The designer of the Pyramid's constructional details foresaw that the slightest tremor due to adjacent cavern collapses—which collapses in such strata are the minor causes of earthquakes—would disturb the precarious stability of the strata below the Pyramid. He foresaw that the central mass of the Pyramid's masonry, in such case, would bring its maximum intensity of pressure to bear upon a square considerably internal to the Pyramid's base square; and that such local concentration of pressure would, by dynamic impulse of momentary subsidence due to Earth tremor, punch the central area, along its fissure surfaces, below the level of the natural rock base.

Terraced rock core for purpose of inducing arching effect in courses under subsidence, and as a "shock-absorber" to "throttle" dynamic movements due to Earth tremors accompanying or causing subsidence.

To meet this eventuality, the natural rock was left terraced upwards towards the Pyramid's centre. The constructional object of this was obviously to form the nucleus of an arch, so that when the terraced centre was affected by local Earth tremor, the momentary impulse of the central mass of masonry should, by the accentuation of "flat-arching," be largely diverted as arch thrust effect clear of the central area. The design, in effect, provided a shock-absorber; but a shock-absorber designed to "throttle" two separate shocks, or series of shocks.

The first shock was that instantaneously reacting to the Earth tremor, producing vertical movement. Vertical movement of the fissured area—like the effect of central failure, due to shearing, on the fixed ends of a beam—produced the second series of shocks: (1) an upward and outward kick of the freed external strata; and, on its completion, (2) a reaction wave outwards from its centre. Both these secondary effects were "damped" or "throttled" by the incidental thrust of the arching effect noted.

The undulatory movement that jolted the South base centre further inwards than the North base centre was moved inwards.

The "echoing" return of the latter ground wave—always accompanying such earthquake effects—would produce, as it does in such earthquake movements, an undulatory movement inwards towards the centre. This would be largely resisted by the terraced natural rock core. Nevertheless, and for the reasons noted in ¶ 182, the centre of the South base was jolted inwards 2.17 B″, and the centre of the North base 1.04 B″.

¶ 188. THE SOUTH AND NORTH MOVEMENT OF MASONRY COURSES.

That the "shock-absorber" detail of construction has served its purpose justifies the principles of design and the forethought displayed in regard to subsidence.

Plate XXXI indicates the central "punched-in" area of maximum subsidence. This effect would have been considerably increased had the central terracing of the natural rock core been omitted. This "shock-absorber" detail has made it possible at this date to derive from the existing measurements and structural indications, the precise purpose of the Pyramid's design and construction. We may, therefore, take it as certain that the design of the constructional details has effected its purpose. The designer of these details has therefore been justified in his conclusions concerning subsidence,

and in his design to meet the effects of such subsidence as he inferred might take place, and that has taken place.

Central fissured base area of natural rock has been "punched" downwards to a greater extent near South base side than near North base side.

The indications supplied by the variations in level of the Passages have determined the subsidence of the masonry courses. These, as shown on Plate XXXI, indicate that the "punched-in" area of fissured rock is more deeply "punched-in" near the South base side than near the North base side. This shows that the dip of the courses inwards on the South side is steeper than on the North side; and that, in consequence, the surrounding undulatory movement due to the "echoing" Earth wave, mentioned in ¶¶ 182 and 187, would have the effect of jolting the whole of the southern portion of the masonry bodily inwards, producing a relative horizontal movement along successive courses from base to apex. This relative movement of courses would increase the horizontal slip between courses in proportion to the height of a course above the base, this increase being due to the decrease of superimposed mass, and to the consequent increased opening of vertical East to West joints towards the North face.

Owing to this the returning undulatory movement (echo) of the subsidence Earth wave produced an eddy below the base, jolting the masonry inwards to the greatest extent at centre of South base side.

¶ 189. THE JOLTING OPEN OF JOINTS IN THE NORTHERN SIDE OF THE CORE MASONRY.

Experimental illustration of manner in which above movement produced a general South to North slide of the courses.

The reader can experimentally obtain the conditions of the last effect for himself. Place a long line of blocks in end-to-end contact on a table and build on this successive similar and equal courses of end-to-end blocks, in such manner that all the initial ends butt firmly against a rigid vertical board. Strike the rigid vertical board with a hammer and examine the end-to-end joints between blocks in each successive course. The end-to-end joints near the vertical board will generally remain tightly closed, and will only be found to have opened out towards the further end of the courses, and to an increasing extent for the higher courses. Owing to the latter effect, the originally vertical surface formed by the ends of the courses away from the source of shock will be found to be inclining over.

The measured effect of this slide in the Pyramid's masonry.

The opening out of the masonry joints North of the Pyramid's centre, and increasing to a maximum at the summit.

If the effect described took place in the Pyramid from the South side, as all the structural and subsidence evidences have indicated, then the existing top platform of the Pyramid should show a greater distance from the Pyramid's centre to the North face of the core escarpment than from the Pyramid's centre to the South, East, and West core escarpments. Petrie gives the distances obtained by him at the mean level of 5408.5 B″ above the base as follows:—

	Mean.
Centre of Pyramid base horizontally to the core masonry faces on the	N. side 224.5±0.7
	E. side 214.1±0.3
	S. side 215.0±0.4
	W. side 217.6±1.0

thus confirming the movement as described.

Thus it will be seen that, although the distance to the South core face is only 0.85 B″ less than the mean of the distances to the East and West core

faces, the distance to the North core face is 8.65 B″ greater than the latter. It is this extra distance that has made the existing angle of slope 51° 54′ 24″ from the centre of the North core base to the top core platform,[1] whereas the existing angles of slope of the centres of the South, East, and West core escarpments are not appreciably different from the original angle of 51° 51′ 14″.3.

Central slope of South, East, and West core escarpments, 51° 51′ 14″, but for North core escarpment, 51° 54′ 24″.

¶ 190. THE GEOLOGICAL DATA.

When it is remembered that the stratification of the Gizeh Plateau, upon which the Great Pyramid stands, and of the whole of the adjacent Nile Valley consists of limestone, the geological reasons for the subsidence effects are clearly to hand.[2] ' The Nile bed itself is formed in a great limestone fault, " eroded into a gorge, fed by water-tunnelled caverns in the cliffs," and now " filled with debris, forming the present Nile bed." Here are evidences of the cause of subsidence, in the examples of collapses of underground caverns and grottos. As Petrie states,[3] " large caverns have collapsed at some hundreds of feet below the present Nile (Fig. 4)."

Strata of Gizeh Plateau and Nile Valley limestone.

Nile bed a limestone fault.

Water-tunnelled caverns.

Collapses of these.

One such smaller cavern or grotto, but not collapsed, is already known under the Pyramid masonry (Plate XXXI), and within the natural rock core, terraced to receive and to bind into the masonry courses of the Pyramid. Not this grotto, however, but a larger unexplored cavern, by collapsing prior to the Pyramid's construction, has been the cause of the rock fissuring and instability of strata discussed in ¶¶ 186–188.

Grotto in Pyramid's terraced rock core.

A deeper cavern indicated by fissures.

¶ 191. THE EARLIEST FORCED ENTRY TO UPPER CHAMBERS.

The Pyramid's structural indications are fairly conclusive that subsidence effects were observed on the external surface of the Pyramid not long after it was built, possibly within a few generations from the time of its construction, and certainly before precise details and measurements of its internal construction were lost or forgotten. The latter conclusion is certain from the entry for examination of the effects of the subsidence upon the Chambers.

External effects of Pyramid subsidence shown not many generations after construction, when data concerning construction still known.

When the Pyramid was built, all access to its upper chambers was closed by the granite plug or plugs at the lower end of the 1st Ascending Passage (Plate XXXI). To hide the fact that a Passage began here, a limestone block was inserted to make the roof of the Entrance or Descending Passage

All access to Ascending Passages originally closed.

Access to Descending Passage and Subterranean Chamber only.

[1]It will be observed that this general angle for the entire centre line of the North core escarpment from base to existing top platform agrees with the existing indications of casing slope for North face, from existing casing base to Entrance sill indicated by existing line of Entrance Passage, and its intersection with the existing base level of the 19th masonry course, near the existing Entrance. The latter definition, as obtained by Petrie, gives existing angle of North face casing, in its first 700 inches of height, as 51° 53′ 20″±1′. (Refer ¶ 180.)

[2]Refer Petrie's " Hist. Egypt," Vol. I (1894 Edit.), pp. 1–6.

[3]Ibid., pp. 3 and 4, illustr. Fig. 4. For such collapses originating earthquakes, refer Sir Archibald Geikie's " Text-book of Geology," pp. 369, 477–479.

PLATE XXXII.

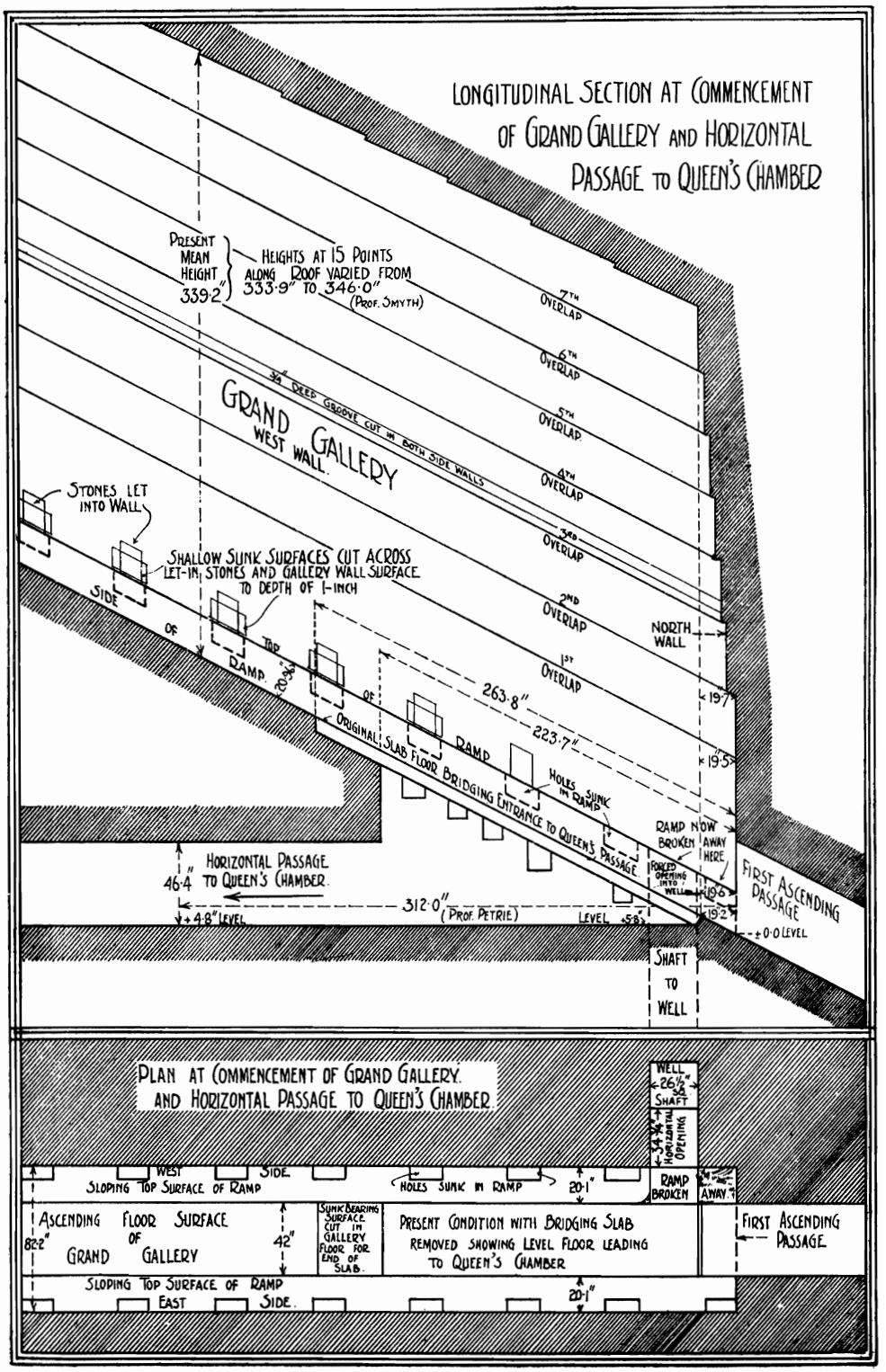
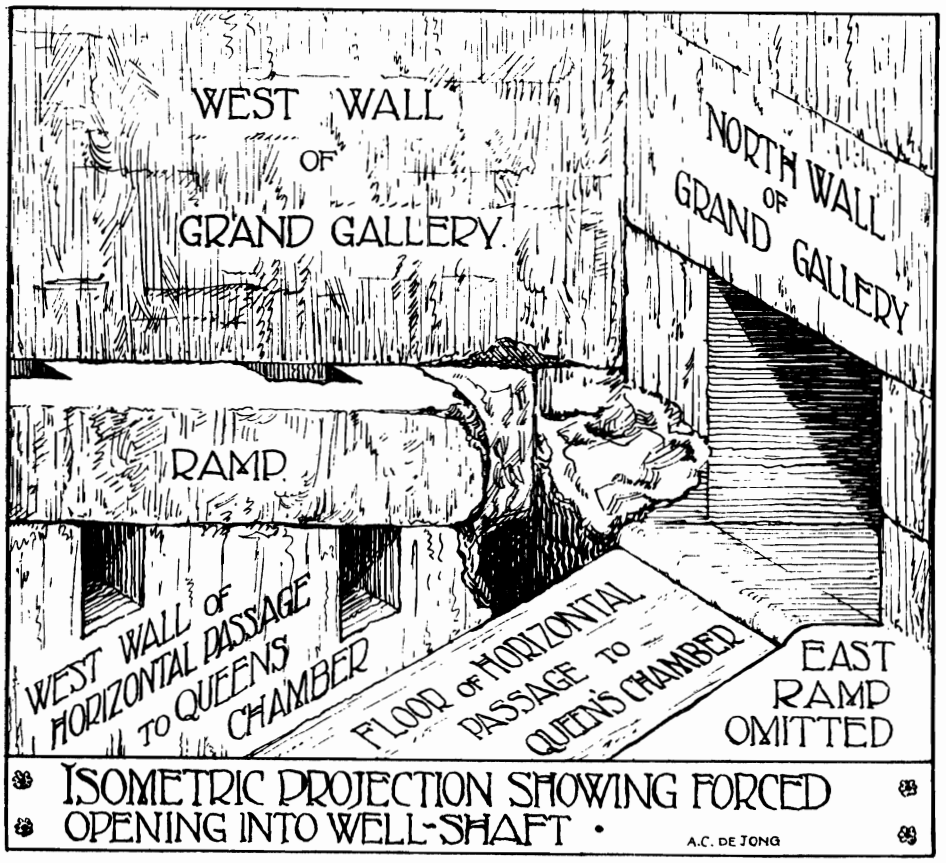

LONGITUDINAL SECTION AT COMMENCEMENT OF GRAND GALLERY AND HORIZONTAL PASSAGE TO QUEEN'S CHAMBER
PRESENT MEAN HEIGHT 339·2″
HEIGHTS AT 15 POINTS ALONG ROOF VARIED FROM 333·9″ TO 346·0″ (PROF. SMYTH)
7TH OVERLAP
6TH OVERLAP
5TH OVERLAP
4TH OVERLAP
3RD OVERLAP
2ND OVERLAP
1ST OVERLAP
GRAND GALLERY
WEST WALL
NORTH WALL
1″ DEEP GROOVE CUT IN BOTH SIDE WALLS
STONES LET INTO WALL
SHALLOW SUNK SURFACES CUT ACROSS LET-IN STONES AND GALLERY WALL SURFACE TO DEPTH OF 1-INCH
SIDE OF RAMP
TOP OF RAMP
20·3″
263·8″
223·7″
19·7
19·5
ORIGINAL SLAB FLOOR BRIDGING ENTRANCE TO QUEEN'S PASSAGE
RAMP
HOLES SUNK IN RAMP
RAMP NOW BROKEN AWAY HERE
FORCED OPENING INTO WELL
19·6
19·2
FIRST ASCENDING PASSAGE
HORIZONTAL PASSAGE TO QUEEN'S CHAMBER
46·4″
+4·8″ LEVEL
312·0″ (PROF. PETRIE)
LEVEL 58°
+0·0 LEVEL
SHAFT TO WELL
PLAN AT COMMENCEMENT OF GRAND GALLERY AND HORIZONTAL PASSAGE TO QUEEN'S CHAMBER
WELL SHAFT
26½″
34·3″
HORIZONTAL PASSAGE OPENING
WEST SIDE
SLOPING TOP SURFACE OF RAMP
HOLES SUNK IN RAMP
20·1″
RAMP BROKEN AWAY
ASCENDING FLOOR SURFACE OF GRAND GALLERY
82·2″
42″
SUNK BEARING SURFACE CUT IN GALLERY FLOOR FOR END OF SLAB.
PRESENT CONDITION WITH BRIDGING SLAB REMOVED SHOWING LEVEL FLOOR LEADING TO QUEEN'S CHAMBER
FIRST ASCENDING PASSAGE
SLOPING TOP SURFACE OF RAMP
EAST SIDE
20·1″

PLATE XXXIII.



continuous past the 1st Ascending Passage. Entry to the upper chambers was thus effectively closed. It was possible only to use the Descending Passage to gain entry to the Subterranean Chamber.

The early forced entry to upper Passages, etc.

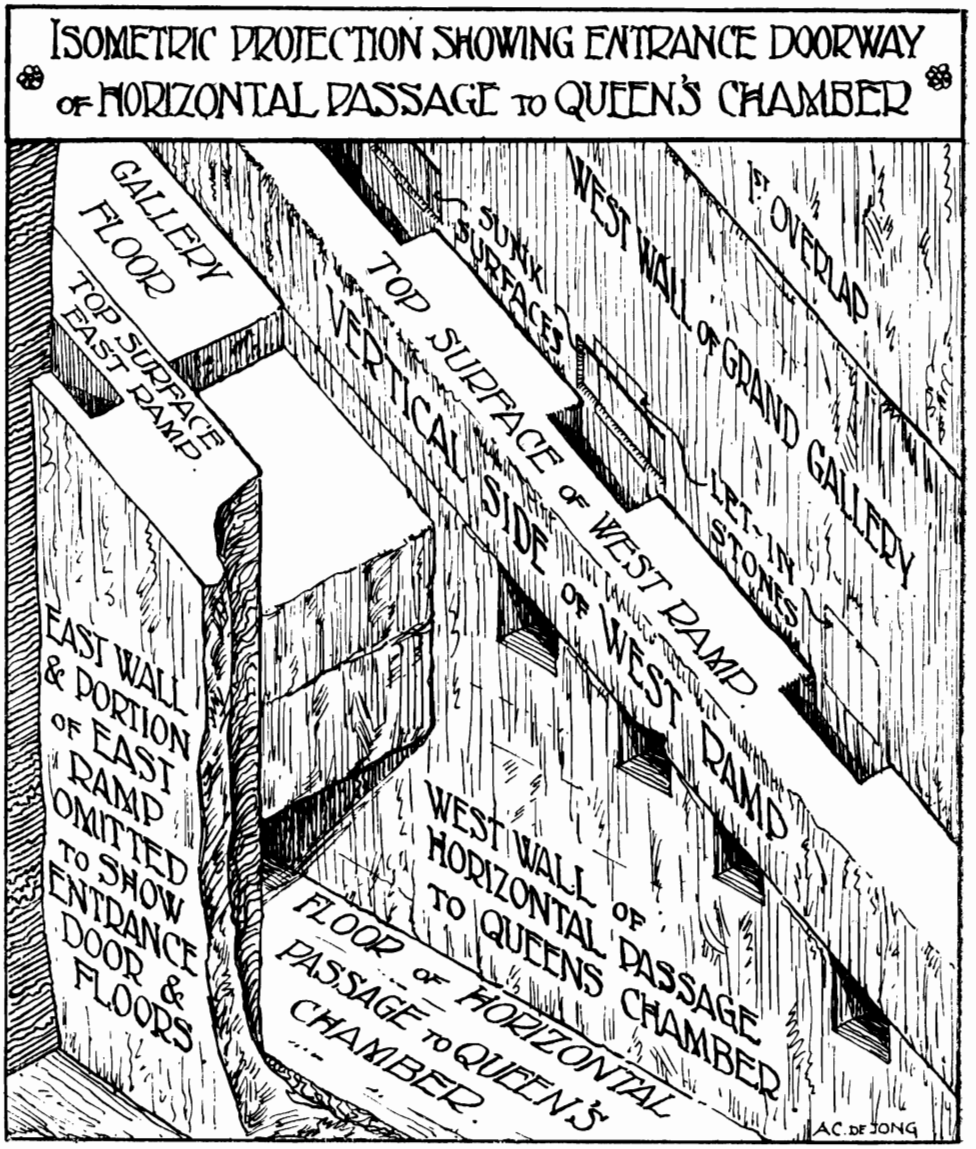
When it was observed, however, that an internal movement had taken place, steps were taken by the keepers of the Pyramid to force an entry. The manner in which this entry was effected forces us to two conclusions:

Manner in which effected confirms Arab accounts of limestone plugs, and that data of construction still known when early entry was made.

(1) That the Arab accounts of Al Mamoun's later forced entry in the 9th century A.D. are correct in stating that the 1st Ascending Passage above the plugs was filled with limestone blocks, which had to be broken up one by one, by the Arabs (refer also ¶¶ 208 and 208a); and

(2) That the plans of the Pyramid, or the data of its construction and ground conditions, were still in existence when the first entry was effected for inspection.

PLATE XXXIV.



¶ 192. THE TUNNELLING OF THE WELL-SHAFT.

Entry by tunnelling up through natural rock to grotto.

Instead of seeking to tunnel through the masonry as the Arabs did later, the early keepers of the Pyramid commenced their tunnelling in a gradually sloping direction from the Descending Passage, up through the natural rock terracing to the grotto (Plate XXXI). Here they organised their depot for tools and rest, and for the bye-passing of workers and materials. Their

reason for commencing their tunnel so deep in the natural rock was obviously to intersect, for purpose of inspection, the two fissures, PQ and MN, shown on Plate XXXI. This seems to indicate that the fissures not built up in the Descending Passage had developed as newly visible in the Passage at the time of the subsidence that had occasioned the visit of inspection considered.

Grotto selected and organised as depot and bye-pass.

From the grotto they then continued with a rough shaft approaching towards the commencement of the Grand Gallery. When they had proceeded sufficiently far with this, by their rough initial methods of aligning, they made an accurate survey from a fixed point of the Pyramid's construction to determine the exact location of their tunnel end in azimuth, altitude, and distance from this fixed point. Referring to the then known data concerning the Pyramid's interior, the keepers thus obtained the location of their tunnel end in relation to the end of the Grand Gallery. They next continued their rough tunnel to a point vertically behind the first (lowest) ramp stone on the West side of the Grand Gallery. This effected, a perfectly vertical shaft—the so-called Well-shaft—was driven upwards to the predetermined point at which the keepers intended to force an entry into the Gallery. Reaching this point behind the first ramp stone, as shown on the Frontispiece (right-hand view) and Plate XXXII (plan), they forced the ramp stone upwards and outwards. That this is the manner in which the ramp stone was forced is shown by the fractured appearance of the ramp around the Well-shaft. This is accurately illustrated on the Isometric Projection shown on Plate XXXIII.

Accurate setting out of forced tunnel to enter West lower end of Grand Gallery ramp.

Ramp stone forced out from vertical tunnel shaft into Grand Gallery.

¶ 193. THE EARLIEST INSPECTION OF THE SEALED CHAMBERS.

Having gained an entry, the keepers proceeded to an inspection of the Chambers. To inspect the Queen's Chamber, they had, perforce, to break or remove the Grand Gallery floor slab that originally bridged the Entrance Passage to the Queen's Chamber, as indicated by the existing details. These are as shown on Frontispiece (right-hand view), and Plates XXXII, XXXIII, and XXXIV. This done, they found little or no serious indications of failure in the Queen's Chamber.

The opening of the Grand Gallery floor slab covering Entrance to Queen's Chamber.

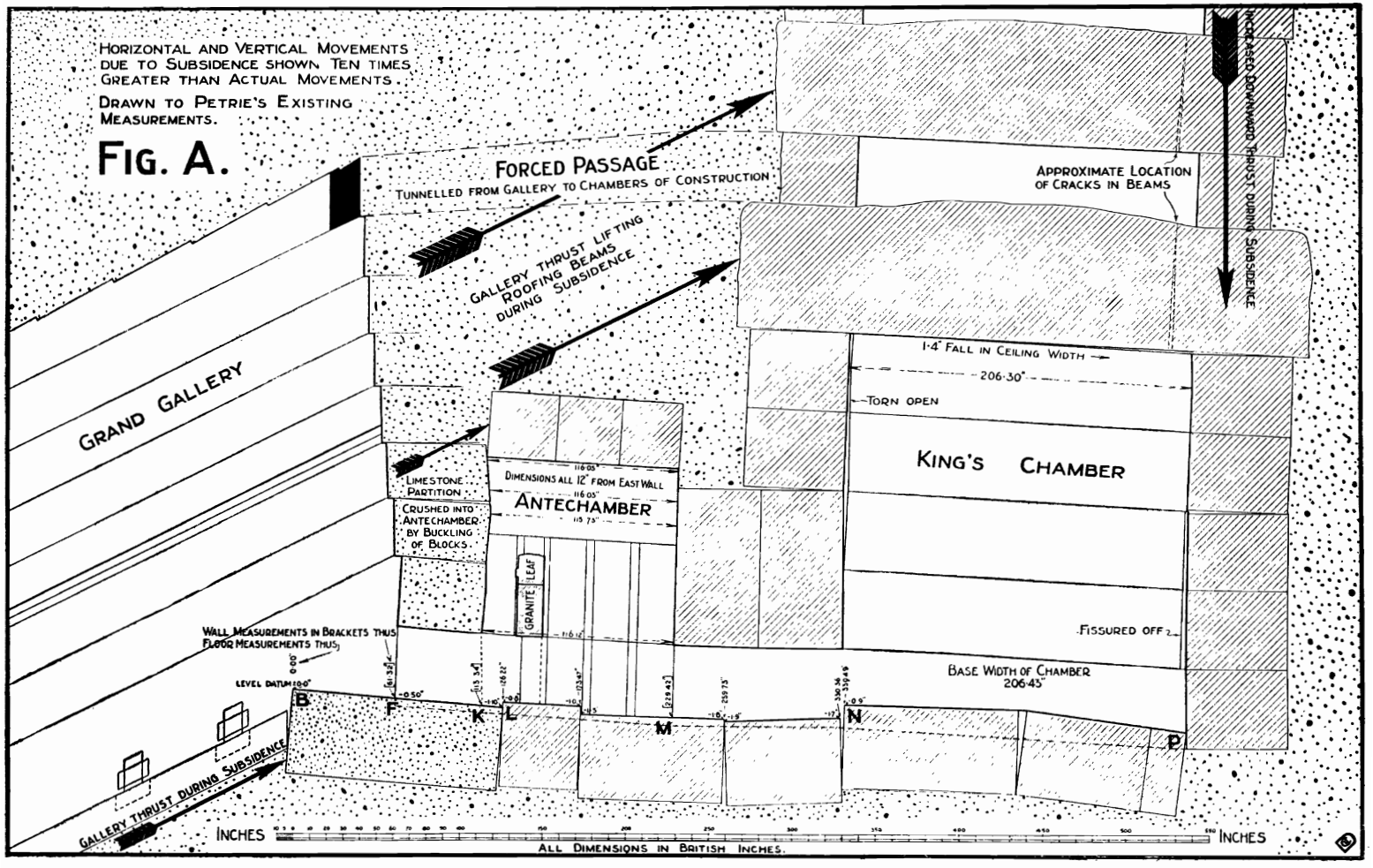
Proceeding to the Antechamber and King's Chamber, they found here indications of possible instability due to the movement that had caused inspection to be made. In the King's Chamber they found the ceiling beams cracked along their South ends inside the Chamber. The cause of this fracture is clearly indicated by the general form of subsidence shown on Plates XXXI and XXXV. To enable any further movement or fracture to be indicated, the keepers evidently smeared the cracks and open joints with cement or plaster. Thus Petrie states, regarding these ceiling-beams, that " Round the S.E. corner, for about 5 feet on each side, the joint is daubed up with cement, laid on by fingers. The crack across the Eastern Roof-beam has been also daubed with cement, looking, *therefore*, as

Inspection of Antechamber and King's Chamber.

Visible cracks and openings cemented over or plastered to give indications of furth movement.

PLATE XXXVa.

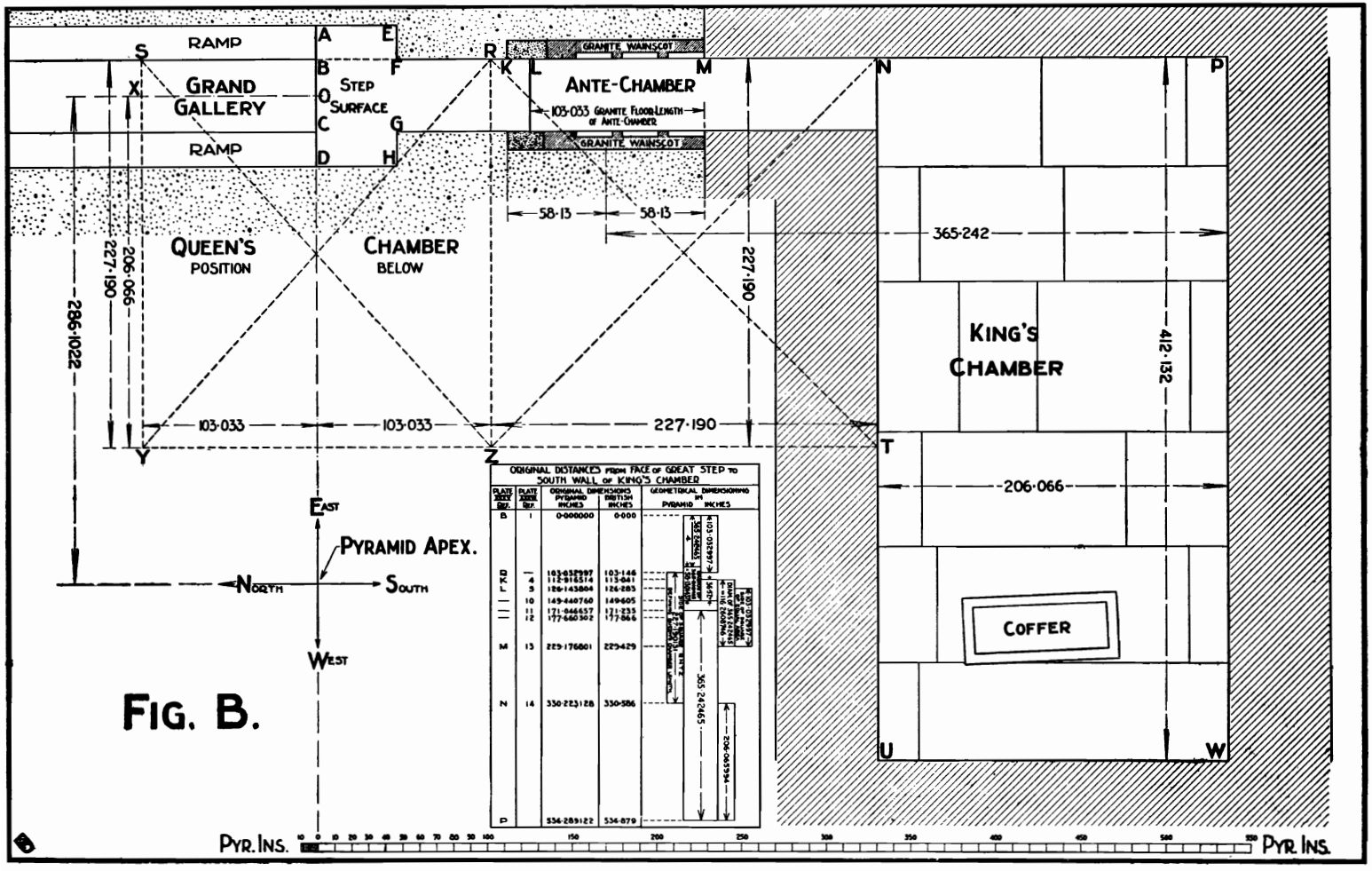
SUBSIDENCE DISTORTION DIAGRAM OF EXISTING KING'S CHAMBER, ANTECHAMBER, ETC.



In Section—Limestone Stippled : Granite Hatched in Parallel Lines

PLATE XXXVb.

PLAN OF KING'S CHAMBER, ANTECHAMBER, AND QUEEN'S CHAMBER—ORIGINAL MEASUREMENTS.



In Section—Limestone Stippled ; Granite Hatched in Parallel Lines.

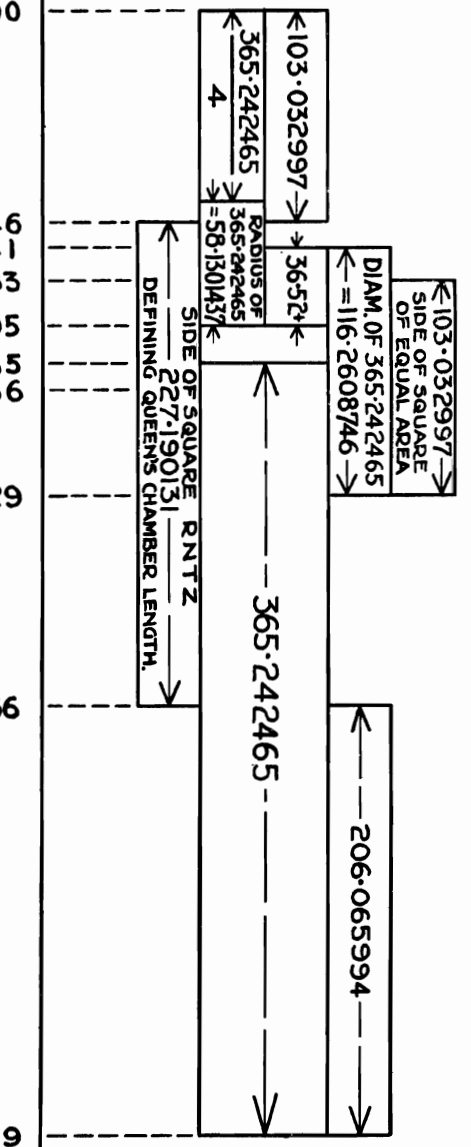
For Enlargement of Table, see Addendum to Plate XXXV.

ADDENDUM TO PLATE XXXV.

ORIGINAL DISTANCES FROM FACE OF GREAT STEP TO SOUTH WALL OF KING'S CHAMBER

PLATE XXXV REF.	PLATE XXXVI REF.	ORIGINAL DIMENSIONS PYRAMID INCHES	ORIGINAL DIMENSIONS BRITISH INCHES
B	1	0·000000	0·000
R	—	103·032997	103·146
K	4	112·916514	113·041
L	5	126·143804	126·283
—	10	149·440760	149·605
—	11	171·046657	171·235
—	12	177·660302	177·866
M	13	229·176801	229·429
N	14	330·223128	330·586
P		536·289122	536·879

GEOMETRICAL DIMENSIONING IN PYRAMID INCHES



it it had cracked *before* the chamber was finished. At the S.W. corner, plaster is freely spread over the granite, covering about a square foot altogether." (The first *italics* are ours, the second Professor Petrie's own.)

¶ 194. THE INSPECTION TUNNEL TO CHAMBERS OF CONSTRUCTION.

To gain access to the important Chambers of Construction over the King's Chamber, the keepers next drove an opening into the East wall of the Grand Gallery at its upper or South end. This is as shown on the Frontispiece and Plate XXXVI.

Inspection tunnel driven from top of Grand Gallery to upper surface of King's Chamber ceiling beams.

Higher Chambers of Construction built weaker to give way slightly under subsiding superimposed load.

Tunnelling clear of the wall blocks of the Gallery, the workers turned their tunnel towards the South, as shown on Plate XXXVI, to enter the Chambers of Construction at the upper level of the ceiling blocks of the King's Chamber. Here they found that the indications of instability were not so serious as they had feared, for they did not proceed higher than the 1st Chamber with their inspection.[1] Modern tunnelling upwards into the four higher Chambers has shown that the use of limestone (in lieu of granite) supporting blocks, bearing the ends of the higher granite roofing beams, has caused the shock of subsidence to be partly broken by crushing and " plastic " flow of the limestone. In other words, the higher Chambers of Construction were purposely built weaker than the lowest Chamber and ceiling beams of the King's Chamber, to act as a succession of " buffers " between the superimposed mass of the Pyramid and the King's Chamber, during the expected subsidence movement.

Object being to break the shock of direct communication to the more rigid construction of lowest Chamber of Construction and King's Chamber.

To permit of this " buffer " effect being fully developed, the beams or slabs of the Chambers of Construction were not built into the East and West walls, from which, as shown by the adhering plaster, the upper Chamber has subsided as much as 3 inches. Hence, instead of indicating bad workmanship —as has been supposed by some authorities not conversant with the design of constructional devices for counteracting the effects of subsidence movement that cannot be prevented — the workmanship in these Chambers is the necessary effect of good design. An entirely rigid system of construction, with uniform workmanship from the lowest to the highest Chamber, would

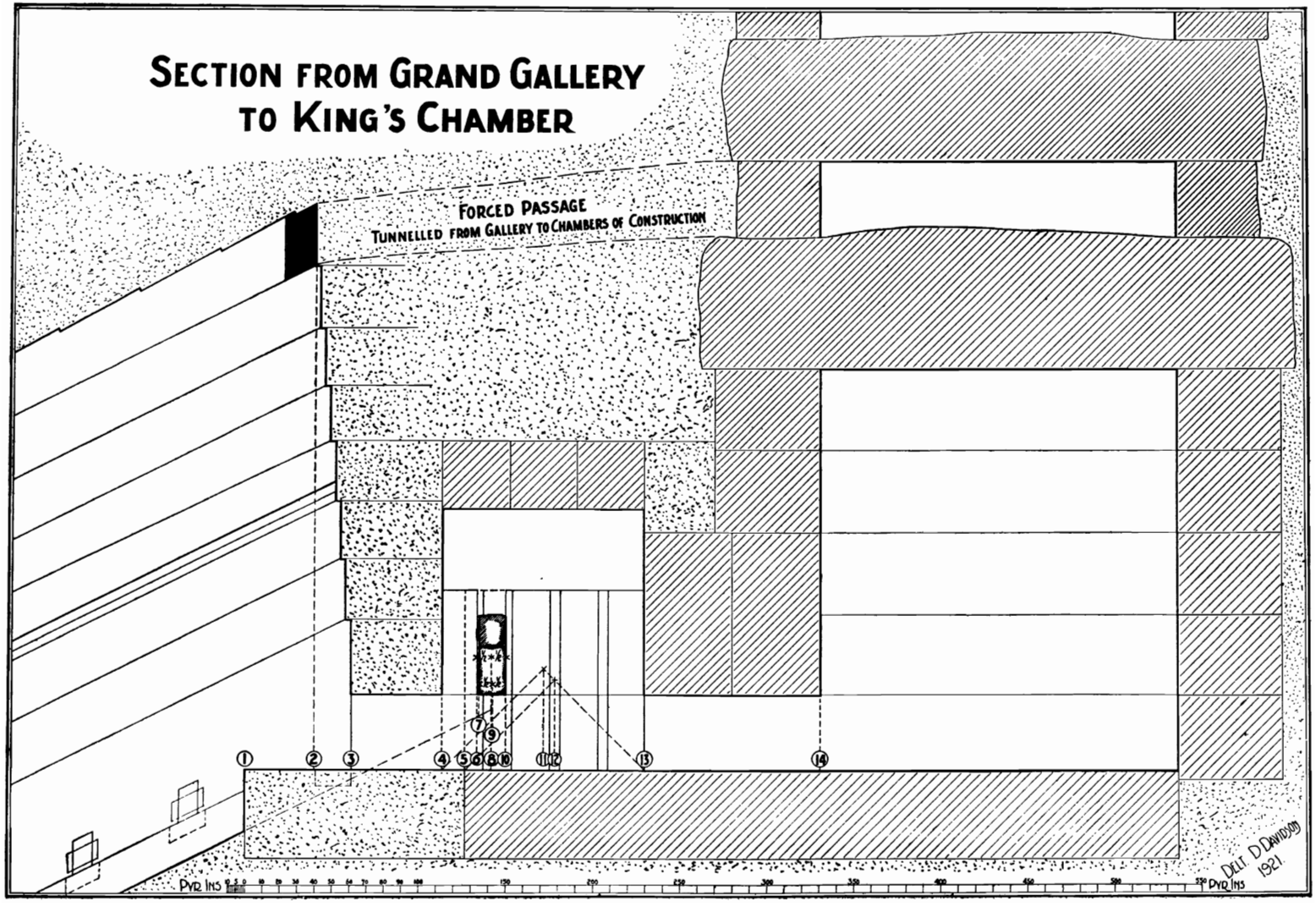
[1]The question of an early forced entry into the Pyramid for inspection has been discussed at greater length than many readers may deem to be warranted by the relative importance of the facts. The reason is that many theories of intention have been attached to the so-called " Well-shaft "—by which we deem this earliest entry was made—and to the access tunnel to the Chambers of Construction.

We have tried to shorten the presentation of what seemed to us to be the true explanation, by adopting the narrative form rather than the inductive form of presenting the data. The reader, therefore, should understand that where the narrative form may seem to savour of assertion, in the presentation of what actually has been evolved by inductive analysis, this is entirely due to the abbreviated form adopted. Where assertion may seem to exist, the reader, it is hoped, will find the confirming data in the context.

Two facts of importance in this connection are (1) that the ramp stone in the Grand Gallery clearly was forced into the Grand Gallery from the so-called Well-shaft; and (2) that the forced inlets were evidently all carefully selected to be at such points as would not destroy or interfere with the purpose of any essential feature of the Pyramid's Passage construction.

PLATE XXXVI.

Limestone in Section shown in Stippled Effect ; Granite in Section shown Hatched in Parallel Lines.



have been disastrous. A voussoir arch construction would have been more disastrous still, as the final stage of settlement has produced an opening out of the King's Chamber walls. This opening out, in conjunction with the tilting thrust from the Grand Gallery, illustrated on Plate XXXV, Fig. A, would have produced a rocking motion and a kicking-up effect on the North haunching of a voussoir arch construction, as well as an opening out of the span of the arch. The complicated combination of stress movements between the voussoirs would have produced failure.

SECTION III.—DETAILS CONCERNING PLATES.

¶ 195. PLATE XIX. THE REDUCED CO-ORDINATES OF PROFESSOR PETRIE'S SURVEY DATA.

Plate XIX for technical reader only.

The data given on Plate XIX are self-explanatory to the technical reader. The purpose of the Plate is to enable the technical reader to check the calculations giving the co-ordinates of Plate XX.

Supplies data for co-ordinates of Plate XX.

It should be sufficient for the general reader to observe how closely the newly calculated co-ordinates of Plate XX agree with Professor Petrie's calculated distances, as given on Plate XX.

Close agreement with Petrie's data.

¶ 196. PLATE XX. THE MEASUREMENTS AND LEVELS OF THE EXISTING DETAILS OF THE GREAT PYRAMID'S EXTERIOR.

Sources of data.

The data given on Plate XX are self-explanatory. The direct measurements of the base square are Professor Petrie's. The true Pyramid azimuth co-ordinate measurements are from Petrie's survey data given on Plate XIX. The plan of the base sockets—shown to a magnified scale as compared with the scale of base co-ordinates—is from Professor Smyth's "Life and Work," Vol. I, p. 138, etc.

Related movements due to ground subsidence and consequent reactions on Pyramid masonry courses.

As explained in Sections I and II of this Chapter, ground subsidence has shifted the sockets, both in relation to their original azimuth and in relation to each other, and at the same time, by consequent minor earthquake effects has shifted the base courses of the Pyramid in relation to the shifted positions of the sockets. The sum of all apparent movements, as examined in detail, varies from $\frac{2}{3}$ of an inch to $3\frac{1}{2}$ inches. (¶¶ 141–145, 180–182.)

The adopted azimuth system.

What we have termed the Pyramid's "true azimuth co-ordinate system" is the azimuth system as defined by the existing socket corners—outmost from the Pyramid's base centre. This azimuth system was adopted as the system of reference for the various related—primary and secondary—movements.

The point of origin for setting out the base square and the oriented definition of the distance between the Pyramid's East and West sides.

The existing evidences of the various related movements have shown (¶¶ 145, 180, and 181) that the point M of the S.E. socket was adopted as the point of origin for setting out the Pyramid's base square and diagonals, and that the distance between the East side of the latter socket and the West side UX of the S.W. socket defined the length of the Pyramid's base side. Even in the event of the technical reader failing to agree with all our conclusions concerning the related base movements, it will nevertheless have to be conceded that the point M

Preliminary or final?

formed the point of origin for preliminary setting out, and that the distance between the East side of the S.E. socket and the West side of the S.W. socket formed the preliminary definition of the Pyramid's base width from East to West. (¶¶ 145, 180, and 181.)

The Pyramid courses.

The levels of the Pyramid courses are as obtained by Petrie. The reader should note that the geometrical considerations of Plates XXIII, XXIV, and XXV (Fig. A_2)

The geometrically defined special apex Pyramid in relation to the existing topmost course.

require that the special apex Pyramid should be 364.27665 P″=364.68 B″ high. The Pyramid's geometrical height being 5813.01 P″=5819.40 B″ gives base of original apex Pyramid, or top surface of the highest course of masonry at 5454.72 B″ above the base. This agrees with the highest existing course, the 203rd course, at 5451.8 B″, thus leaving 2.9 B″ for subsidence of the highest course. Owing to the

cumulative effect of the flat-arching of the courses, from the centre of the base to the topmost course, as explained in ¶¶ 183 and 184, the subsidence at the apex would not be more than this. The special apex Pyramid would not be a single apex stone, but an apex Pyramid of finer (casing) limestone. The reader must not confuse the apex Pyramid with the apex stone.

¶ 196a. THE CEREMONY OF ORIENTING THE FOUNDATION.

Egyptian evidence as to the antiquity of the ceremony of setting out the foundation.

The ceremony of setting out—or orienting—the foundations of a building is extremely ancient. The ceremony was known as " the stretching of the cord." It is referred to, without explanation, in an Egyptian inscription of Amenemhat I, the first king of Dynasty XII. At that time the ceremony was already ancient.

References to the ceremony in the Old Testament.

The " measuring cord " is allegorically taken as defining the function of Israel in relation to the world in Deut. xxxii, 8 and 9, and context. In verse 9 the true rendering of the Hebrew reads " Jacob is the measuring cord of His inheritance." Again in Job xxxviii, 4, 5, and 6, the " stretching of the cord " and the cutting of the sockets for defining the laying out of the foundations are referred to as follows :—

The stretching of the cord, the sockets, and the corner stone referred to in Job.

> " Where wast thou when I laid the foundations of the earth ? . . .
> " Who hath laid the measures thereof ? . . .
> " Who hath stretched the line (or cord) upon it ?
> " Whereupon are the sockets made to sink ? or who laid the corner stone thereof ? "

Star alignments.

The Egyptian inscriptions generally indicate the process of orientation being effected by " stretching the cord " on an alignment towards a particular star. All the astronomical and Egyptological data in relation to this are fully discussed in Sir Norman Lockyer's " Dawn of Astronomy."[1]

¶ 196b. THE GODDESS OF THE FOUNDATION.

The goddess Sefkhet-Ãâbut and the foundation ceremony.

In the Egyptian sculptures and texts the goddess Sefkhet-Ãâbut[2] — " the goddess of the laying of the foundation," and the goddess associated with the chronological repetitions of " seven "—is pictured as assisting the king in the ceremony of " stretching the cord. ' This goddess is represented as the guardian of the cycles of 30 and 120 years, and is pictured accompanied by the symbols of these. In consequence, the principal foundation ceremonies were held at the festivals of the termination of these cycles. Obviously the chronological aspect of her connection with " seven " relates to the seven primary cycles of 103 years, which were equal to six groups of *Sep tep sed* periods (¶ 34).

" Stretching the cord."

The guardian of chronological repetitions of " seven."

The " Sed Hebs " and the series of seven cycles of 103 years.

The emblem of the Noachian rainbow covenant.

The jewelled collar of Ishtar.

Chinese connection.

The rainbow covenant in Chinese tradition.

The head-dress of the goddess consists of an arch, or pair of horns inverted, over a seven-rayed star, or seven-petalled flower. Here we have, apparently, a hieroglyphic representation of the rainbow, which in the Babylonian goddess Ishtar is signified by " the jewelled collar of Ishtar."[3] The Rev. C. J. Ball shows that the latter symbol was derived from the Chinese. Accordingly we find that the Chinese equivalent of Noah, the patriarch Fu-hi, was " born of a rainbow," " was manifested on the mountains of Chin, immediately after that great division of time which was produced by the deluge," and that " he carefully bred *seven* different kinds of animals which he used to sacrifice to the Great Spirit of heaven and earth."[4]

[1]The only criticism one feels inclined to offer in connection with this work is that Lockyer seems to have had too few definitive statements of alignment and too many stars upon which to align. He was, therefore, able to fix many of his datings in accordance with systems of Egyptological chronology that are not now accepted. Criticism, however, does not apply to his solar alignments. Refer ¶¶ 1–4 and footnotes.

[2]Budge, " Gods of the Egyptians," Vol. I, pp. 424–426 and 430.

[3]Rev. C. J. Ball, " Light from the East," pp. 40 and 201.

[4]Faber's " Pagan Idolatry," Vol. II, pp. 343–344.

¶ 196c. THE DELUGE ELEMENT AND EPOCH.

The rainbow goddess, Iris = Aphrodite = Hathor.

Sefkhet-Āâbut an aspect of Hathor.

Hathor, and the Rainbow Covenant in Egyptian Deluge traditions.

The seven Hathors and the Pleiades in relation to rain and the Deluge.

Pleiades the "Foundation."

Sefkhet-Āâbut the goddess of the foundation.

Evidence that Egyptian "Sed Hebs" began from an epoch that defined the Egyptian date for the Hebrew Deluge.

Confirming the connection suggested, Ball points out that Iris, the goddess of the rainbow, "is associated with Aphrodite (Ishtar) in Homer (II, 5, 353, *seq.*)"; and Budge, that Aphrodite was identified with the Egyptian Hathor,[1] and that the goddess Sefkhet-Āâbut, in one Egyptian representation, is represented as Hathor. The latter, again, was originally, according to Budge, "only one special part of the great watery mass of heaven."[2] The clear meaning of the latter statement becomes apparent when we remember that Hathor was instrumental in effecting the "Destruction of Men" in the Egyptian equivalent of the Deluge narrative (¶ 28). Hence the association with "seven" obviously originated the "seven Hathors"—the seven fairy goddesses of the Egyptians. Obviously, again, these were identified with the "seven *Pleiades*"—associated traditionally with the Deluge (¶ 29)—since, in early Euphratean astronomy, the "seven *Pleiades*" (or particularly, the star *Alcyonê*) were known as "The Foundation."[3]

This completes the identifications associating the goddess Sefkhet-Āâbut, the goddess of the foundation ceremony, with the Deluge rainbow covenant of Gen. ix, 13. The identifications further suggest that the cycles of 30 and 120 years, represented as controlled by the goddess, began from an epoch that was the ancient Egyptian equivalent date for the Hebrew Deluge ending. This is confirmed by the facts concerning the Deluge Calendar of Genesis, and the facts concerning the early Egyptian November year-beginning discussed in Chapter I, Sections I and II.

¶ 196d. THE RAINBOW ANGEL OF REVELATION.

Sefkhet-Āâbut an Egyptian version of the Rainbow Angel of Revelation and the "Palmoni" of Daniel.

The identifications outlined show that the goddess Sefkhet-Āâbut was the Egyptian (female) version of the "Rainbow Angel" of Revelation, Chapters x and xi. It is this angel who defines "the times," as *Palmoni*—"the wonderful numberer"[4] or "numberer of secrets"—in Daniel viii defines "the times." The "Rainbow Angel" "was clothed with a cloud, and a rainbow was upon his head." He was "the Seventh Angel," and at his cry "seven thunders uttered their voices." His final declaration was that "there should be time no longer."[4] Comparing the latter with Daniel viii, 13–19, we see that the functions of *Palmoni* and the Rainbow Angel are identical, and that the Egyptian goddess Sefkhet-Āâbut was represented as exercising the same functions.

¶ 197. PLATE XXI. THE SOUTH-EAST CORNER CASING STONE.

Petrie's reconstruction and the new reconstruction.

Application of Petrie's reconstruction to S.E. corner casing stone shows weakness of resulting detail.

The reconstruction defined as Professor Petrie's in Figs. A, A_1, and A_2, results entirely from his data in the text of his work and from his Plate X. The new reconstruction shown on Figs. B, B_1, and B_2 follows from the data discussed in Sections I and II of this Chapter—particularly in ¶¶ 144, 145, 146, and 196. A model of Petrie's reconstruction for the S.E. corner casing stone will convince any experienced constructional engineer, architect, or building craftsman, that a corner stone of its shape and proportion could not be safely handled into position, and that the stone, in position, would not be reliable. This has been the conclusion, without exception, of many experienced engineers, architects, and contractors, to whom we have shown such a model during the past thirteen years.

Professor Petrie's unfortunate selection, for a typical case, of a socket corner that does not fully define the defects of his reconstruction.

It is unfortunate that Professor Petrie, in selecting one of the four corner stones to define a typical case of his theory of reconstruction for all four, did not select the S.E. corner stone. Had he done so, we feel confident he would have

[1] "Gods of the Egyptians," Vol. I, p. 435.
[2] Ibid., pp. 428–429.
[3] Brown, "Primitive Constellations," Vol. I, p. 57.
[4] In this connection the reader is referred to ¶ 36 and footnote.

revised his theory of reconstruction. Had he been led to a revision of his theory of the sockets and the corner casing stones, it is highly probable that the revision of the latter would have led him to discover the true hollowed-in base plan.

The reader should understand that the new reconstruction shown on Figs. B, B_1, and B_2 may not be absolutely correct in every detail. It is more than probable that the pavement was carried over the socket, and that the casing stone rested on the pavement—in all other respects, precisely as shown on Figs. B_1 and B_2.

For new reconstruction, pavement probably supported the corner casing stones.

¶ 197a. SOCKET DEPOSITS.

What makes the latter alternative probable is the more recently derived evidence from the Lisht Pyramid of Senusert I (Dynasty XII). This is given by Dr. Albert Lithgoe as follows :—[1]

Foundation deposits of Lisht Pyramid sockets.

> " Under the platform (of the Pyramid) there was found at each of the four corners of the Pyramid a ' foundation-deposit.' These were practically identical in character, and in each instance had been placed in a square pocket about 80 cm. in diameter, and 1 metre in depth, excavated in the bed-rock upon which the platform rested. The bottom of the pocket had been covered in each case with about 5 cm. of clean gravel upon which were some 25 to 30 small pottery model dishes and vases, while scattered among them were a number of lozenge-shaped blue glass beads. On these objects were laid the skull and some of the bones of an ox which had been sacrificed as a part of the ceremonial. The pocket had then been completely filled with gravel, on which, at about half its depth, was laid a small model brick of sun-dried Nile mud. Finally the pockets were covered by massive limestone blocks, which in each case formed the corner blocks of the Pyramid platform."

The engineer or architect will probably agree, for the particular case of a corner stone partly resting on the natural rock and partly on socket filling of the nature described for the Lisht Pyramid, that such construction as is shown on Figs. B, B_1, and B_2 would not be altogether good design or construction. In such event, it is likely that the pavement spanned the socket and carried the corner casing stone. Of course, it was the usual Egyptian practice to cover the foundation area of their Pyramids and other heavy constructions with a layer of sand upon which to bed their base blocks. This is good practice so long as the sand is not free to move after bedding. What is not good practice is to have a block such as AGFE on Plan (Fig. B) with its corner A resting on sand or gravel filling and its corner F on bed-rock.

If Great Pyramid sockets filled in as for case described, this would confirm that corner casing stones rested on pavement slabs spanning sockets.

On the other hand, the foundation deposits of the Great Pyramid's sockets may have been filled round with run-in lead,[2] or with other hard filling, in which case the whole foundation area of the Pyramid base—as normal in such work—may have been covered with fine sand internal to the surrounding pavement, the core base blocks, and possibly also the corner casing stones being thereafter laid, as shown on Figs. B_1 and B_2. All known casing blocks near the centre of the four base sides, however, rest upon the pavement, as shown on Plates XXVI–XXIX.

If Great Pyramid sockets filled in with hard filling, corner casing blocks may have rested directly on same, as shown on Plates.

¶ 198. PLATE XXII. ISOMETRIC AND OBLIQUE PROJECTIONS OF SOUTH-EAST CASING STONE.

The isometric and oblique projections of Professor Petrie's reconstruction refer to the defects mentioned in ¶ 197. These two views clearly illustrate the difficulty of handling without injury a stone altogether 8 feet high, according to Petrie's reconstruction, from extreme base to top surface, only 3 feet square on top, and with a base diagonal—AL on Fig. A, Plate XXI—of over 13 feet, ending in the weak projecting footing provided to fit into the socket.

Petrie's S.E. corner casing stone:— Top, 3 feet square ; height, 8 feet ; base diagonal over 13 feet long, ending in weak projecting footing.

[1] Journal " Ancient Egypt," 1915, Part IV, p. 145.

[2] The Coptic tradition of the Masoudi Arabic MS. mentions run-in lead in connection with the Great Pyramid pavement.
Vyse's " Pyramids of Gizeh," Vol. II, Sprenger's Appendix, p. 325.

New reconstruction :— Top, 6 feet square ; Height, 5 feet (or if resting on rock, 6 feet 6 inches) ; base, 9 feet 9 inches square.

The isometric and oblique projections of the corner stone, according to the new reconstruction, give a stone 6 feet square on top, 5 feet high, if resting on the pavement—or 6 feet 6 inches high, if resting on the rock surface—and 9 feet 9 inches square on its base surface. All the known casing stones *in situ* are of this or greater proportion. Many of them are of a much greater top thickness than 6 feet, running into and beyond the mean core surface. This shows that the base casing stone course was thicker than the casing stone courses above it, and hence, in all probability, that the corner base casing stones were larger in plan than is indicated by Plate XXI, Fig. B.[1] Otherwise the casing of the Pyramid is more or less uniform, about 6 feet thick on the top surface of courses.

The effect of the additional thickness given to base course of Pyramid's casing.

Petrie's casing reconstruction requires casing thickness 6 feet up centre of face slopes and 3 feet at the corners, the reverse of good construction.

Petrie's reconstruction requires the 6 feet thickness down the centre of each face slope, and a 3 feet thickness at the corners or approaching the arris edges. This is the reverse of sound construction in any form of building. Additional thickness is more necessary at returns of courses than in straight lengths of courses.

¶ 199. PLATE XXIII. GEOMETRICAL DEFINITION OF PASSAGE DISPLACEMENT.

The basis for the geometrical definition (1) of the Apex Pyramid ; (2) of the hollowing-in feature of the Pyramid's casing slopes ; (3) of the displacement of the Pyramid's Passage System.

In Fig. A, Case I, D_2OD_1 represents the East to West vertical section of the Pyramid.

For Fig. A, Case II, D_2OD_1 represents an apex vertical section whose linear dimensions are $\frac{1}{10}$th the linear dimensions for Case I. This apex section forms the basis for the geometrical definition (1) of the Apex Pyramid ; (2) of the hollowing-in features of the Pyramid's casing slopes ; and (3) of the displacement of the Pyramid's Passage System. Explanation of Case II, as defining the features noted, will also form the explanation for Case I, if 10 times the dimensions of Case II be substituted.

Fig. A, Case II :—

With centre O, and radius $OJ_1 = 581.3014373$ P″, describe the quadrant arc $J_2J_1J_3 = \frac{3652.42465}{4}$ P″. Complete the quadrant $J_3J_1J_2O$.

The geometrical constructions forming the above basis. Fig. A.

With O as apex, and the central radius OJ_1 of the quadrant as perpendicular height, form the triangle D_2OD_1, with base $D_2J_1D_1$ = length of quadrant arc $J_2J_1J_3$. Then area of triangle D_2OD_1 = area of quadrant $J_3J_1J_2O$.

Draw the chord $J_2A_1J_3$ to cut the perpendicular OJ_1 at A_1, and to cut OD_2 at B_2, and OD_1 at B_1. Then $B_2A_1B_1 = \frac{2582.654}{4}$P″, 2582.654 P″ being $\frac{1}{10}$th the Precessional circuit. (Hence for Case I, $B_2A_1B_1$ represents the level of the Precessional circuit.)

Now, with centre O, and radius OA_1, describe the quadrant arc $A_2A_1A_3$, which is of equal length to $B_2A_1B_1$. (Hence for Case I, quadrant $A_3A_1A_2O$ is the quadrant of the Precessional Circle.)

Draw E_3OE_4 through O and parallel to J_2J_3 and D_2D_1. On E_3OE_4 construct the square $E_1E_2E_3E_4$ of area equal to the quadrant area $A_3A_1A_2O$, and equal to the Pyramid sectional area B_1OB_2, and such that $E_3O = E_4O = E_2F_1 = E_1F_1$. Then $OF_1 = E_3E_4 = E_1E_2 = 364.2766547$ P″.

Now produce $E_2F_1E_1$ to cut the Pyramid face line OD_2 at k_3 and OD_1 at k_1. Then $F_1k_3 = F_1k_1 = 286.1022156$ P″. The line $k_3F_1k_1$ represents the level of a square circuit at the Pyramid's apex, of length of side $k_3F_1k_1 = 2F_1k_3 = 2 \times 286.1022156$ P″.

[1] Similar thickening applied to Petrie's reconstruction would necessarily make his detail still weaker for handling and bedding in position.

The plan of this square in relation to the plan of the Pyramid's base square $M_1M_2M_3M_4$ is shown on Fig. B as $N_1N_2N_3N_4$, in which $k_3F_1k_1$ represents the line $k_3F_1k_1$ in Fig. A. Producing N_2N_3 in Fig. B to intersect, in plan, the Pyramid's North base side M_1M_2 at Y, and its South base side at W, gives the line $WN_3k_3N_2Y$ defining the plan of the central vertical axial plane of the Pyramid's Passage System, uniformly removed the distance $YZ=k_3F_1=WU=286.1022156$ P″ eastwards from the Pyramid's North to South central vertical plane, represented in plan by the line UF_1Z. **Fig. B.**

Point T in Fig. B represents the centre of the Entrance Doorway on the North face slope of the Pyramid.

¶ 200. PLATE XXIV. THE COMPLETE GEOMETRY OF THE DISPLACEMENT.

Plate XXIV represents the East to West vertical section R_2OR_1 of the Pyramid, shown in plan as the line R_2R_1 in Fig. B, Plate XXIII. The apex geometrical construction is identical in line and letter references with Case II, Fig. A, Plate XXIII. Plate XXIV diagram is, therefore, a composite representation of the geometrical constructions of Plate XXIII, Figs. A and B. **The composite geometry of Figs. A and B of Plate XXIII.**

The vertical line K_3B_2 represents the elevation, as seen from the North, of the central vertical axial plane of the Passage System, with the point X at height K_3X representing the *level* of the centre of the Entrance Doorway on the North face slope.

With these key explanations the general reader should be able to follow the sequence of geometrical construction in Plates XXIII and XXIV without further elaboration. The sequence of geometrical construction bears an important relation to the geometrical constructions of Plate XXV.

¶ 201. PLATE XXV. THE PYRAMID BASE AND THE EARTH'S ORBIT.

Plate XXV has been sufficiently explained in ¶¶ 153 to 159. One item, however, requires amplifying. This concerns the Pyramid's value for the mean sun distance as compared with the various modern values by different methods. The four principal methods of determination giving reliable results are the following :— **The four principal modern methods of obtaining the sun distance.**

(1) By measurement of planetary parallaxes;
(2) By the velocity of light;
(3) By means of the determination of the relative masses of the Earth and the Sun; and
(4) By means of the parallactic inequality of the Moon's motion.

Results by the four different methods do not precisely agree. The total range of difference is about 500,000 miles. Until they do agree by all four methods—within a minute range of variation—the mean sun distance cannot be stated as known precisely. It is not sufficient for a series of independent observations or calculations by one method alone to agree within a minute range of variation. In such case—until observations or calculations by the other methods agree within the same range of variation—it must be assumed that that agreement has been rendered possible by errors common to the method or apparatus employed. **Range of variation in comparison of values by the four independent methods, 500,000 miles.**

At present the range of variation in the determination of the sun's parallax by the various methods ranges from 8″.762 to 8″.806. These limits give a value for the sun distance ranging from 93,300,000 miles to 92,830,000 miles respectively. The Pyramid's value for the sun distance—92,996,085 miles, as in ¶ 159—represents a parallax of 8″.791, which agrees closely with the added mean of methods (1), (2), and (4), 8″.806, 8″.781, and 8″.773 respectively. Professor Newcomb's experiments in connection with method (2) derived a parallax of 8″.79. **Expression of results by all four methods Sun distance = 93,050,000 ±250,000 miles.**

Present opinion :— Sun distance, 92,900,000± 100,000 miles.

The general *opinion* at the present time is that the sun distance lies between 92,800,000 miles and 93,000,000 miles. Observational astronomers declare in favour of the lower value. The best modern statement, however, is 92,900,000±100,000 miles.

¶ 202. PLATE XXVI. VIEW OF NORTH BASE CASING STONES, LOOKING WESTWARDS.

View in relation to centre of North base side.

Nineteen stones "in situ."

Fourteen stones in good condition, giving base line of 63 feet 4 inches.

One of these limits can be located on the South base side, but is covered with debris.

Plate XXVI gives a general view of the extent of casing stones existing on the North base side. The figure standing at the first casing stone is not many feet removed from the centre of the North base side. The complete extent of pavement shown in the foreground, and extending beyond the casing stones, was uncovered by Mr. L. Dow Covington during 1909 to 1910. The total number of casing stones uncovered is nineteen, of which the first fourteen, in the view shown, give an unbroken base line of 63 feet 4 inches. This is not sufficient to locate the point H of Fig. A, Plate XXV, the western limit of the hollowed-in central surface at the base. To locate this limit, the only known certain point where casing exists at the necessary distance from the centre of a base side is at G on the South base. This has not been cleared. Petrie sunk a shaft through debris at the point noted, and surveyed the points obtained by means of a plumb line. A complete clearance near this point would be necessary to define the change of direction in the South base line.

Attention is directed to the fact that the casing stones sit on the pavement. In his earlier editions, prior to Petrie's survey, Smyth showed the pavement erroneously as the lowest casing course.

¶ 203. PLATE XXVII. VIEW OF NORTH BASE CASING STONES AND AL MAMOUN'S FORCED ENTRANCE.

The figure shown is in the same position as in the view of Plate XXVI. The joints between the casing stones are shown as visible for purpose of illustration. Actually they are only perceptible under the closest inspection.

Account of Al Mamoun's forced entry about 800 A.D.

The curious circumstance that led to access being gained when operations were about to be stopped.

The discovery of the 1st Ascending Passage.

Al Mamoun's forced entrance is shown on the 7th course, and, as pictured, vertically above the first existing casing stone. This entry was made about 800 A.D. in the hopes of obtaining access to the treasures that, according to tradition, were hidden in the Pyramid. A curious circumstance is related in connection with this undertaking. This is to the effect that the excavation—having proceeded a considerable distance into the core masonry—was upon the point of being given up, when the workmen heard what appeared to be the sound of a stone falling, slightly eastwards of their tunnel end. Altering the direction of their tunnel eastwards towards the point indicated by the sound referred to, the workers soon reached the Descending Passage at a point below the junction. Here they found the stone whose fall had redirected their operations. The shape of the stone showed that it had been the roofing stone of the Entrance Passage that had hidden the beginning of the 1st Ascending Passage.

Arab accounts of innumerable limestone blocks broken up, and extracted from 1st Ascending Passage.

Finding that the Descending Passage did not lead to the hoped-for treasure, the workers redirected their attentions to finding an entrance to the 1st Ascending Passage. The Arab accounts relate that many limestone plugs had to be extracted from the Passage above the granite plugs before entrance was effected. (Refer ¶ 191.)

¶ 204. PLATE XXVIII. NEAR VIEW OF NORTH BASE CASING STONES.

Near view of North base showing rock fissure.

The standing figure is again in the same position as in Plates XXVI and XXVII. The fissure below the pavement shown in the left foreground is also shown partly, in the right foreground of Plate XXVI and in section on Plate XXXI, as fissure GH.

¶ 205. PLATE XXIX. GENERAL VIEW OF NORTH BASE SHOWING CASING STONES, AL MAMOUN'S ENTRY, AND EXISTING ENTRANCE TO ENTRANCE PASSAGE.

Constructional feature to prevent subsidence jamming pivoted block of Entrance Doorway.

The figure seated on the 5th course of core masonry is shown pointing to Al Mamoun's forced entry on the 7th course. Above, to the left, is shown the system of relieving slabs or blocks over the beginning of the Entrance Passage, designed to prevent subsidence pressure jamming the vertically rotating pivoted block that originally closed the Entrance Doorway. These relieving blocks are also shown in section over the Entrance in Plate XXXI.

Subsidence effects on casing assisted Arab demolition.

The pivoted doorway was not known to Al Mamoun's workers until after access had been gained by tunnelling; the casing being complete until Arab demolition around 800 A.D. It would appear, however, that subsidence had distorted the casing and buckled it loose on the core masonry, making it a simple matter, once the casing had been undermined near the base, for demolition to continue. Many of the greater buildings of Cairo about 1000 A.D. were built of the casing blocks.

¶ 206. PLATE XXX. EXISTING AND ORIGINAL MEASUREMENTS OF THE GREAT PYRAMID'S PASSAGES.

The bases of the comparative statements of Plate XXX are—

(1) That the original angle of slope of the Passages is known. (¶¶ 176 and 177.)

(2) That the existing sloping lengths of the built portions of the Passages are known, and that critical examination shows that these have not appreciably altered since construction. (¶¶ 180 and 186.)

(3) That, in consequence of (2), subsidence has altered the horizontal and vertical positions of all points along ABCD without appreciably altering their passage floor distances in relation to the points A, B, C, and D. (¶¶ 179, 180, 183, and 185.)

(4) That the floor from the Great Step to the King's Chamber originally lay in one horizontal plane.

(5) That the roof of the horizontal passage to the Queen's Chamber originally lay in one horizontal plane at the level of the termination of the roof of the 1st Ascending Passage.

The bases of the comparative statements of existing and original Passage lengths and their horizontal and vertical co-ordinates.

(6) That subsidence in the natural rock below the Pyramid's base—unlike its effect on the built mass of blocks above—vertically lowered all points in the rock-cut portion of the Descending Passage between C and E, without sensibly moving the points horizontally. (Plate XXX, Table B, Cols. 3 A and B, and note 3 to Table B.)

(7) That, in consequence of (6), floor distances from C towards E were all cumulatively stretched during subsidence, with the maximum amount of extension for the total sloping floor distance CE. (Plate XXX, Table B, Cols. 2 A and B.)

A geometrical datum connecting with the geometrical construction of the 35th course.

(8) That reconstruction on the bases of (6) and (7) shows that E was originally 1162.6 P″ below the base (Plate XXX, Table B, Col. 4 A), this being also the measurement of the height of the 35th course axis above the base.

Sources of existing measurements.

The existing measurements are all from Professor Petrie, except in the case of CE, which Petrie could not measure accurately owing to accumulations of debris. The Edgars,[1] as a result of Dow Covington's clearances in the Descending Passage, were able to measure the length CE as given on Plate XXX.

Petrie's error in stating the horizontal and vertical position of the Great Step.

The horizontal and vertical distances of points in the sloping passages are reduced from Petrie's passage distances, angles, and offsets. The notes to Plate XXX and footnote to ¶ 183 direct attention to an error in Petrie's reduction of his measured

[1] "Great Pyramid Passages," Vol. II, p. 8.

His measurements right, but his reduction in this case in error.

data to the statement of the horizontal and vertical position of the point A, and all points higher and beyond point A in Plate XXX.

For the original horizontal distances from the Great Step into the King's Chamber (Plate XXX, Table A, Col. 3 A) refer Plates XXXV (Table) and XLIII. and ¶¶ 211 c and d.

¶ 207. PLATE XXXI. SUBSIDENCE DISTORTION OF THE GREAT PYRAMID.

Plate XXXI has been prepared from the data given on Plate XXX. Explanation of the relation between Plates XXX and XXXI has been given in ¶¶ 176 to 194.

Existing structural evidence of the cumulative "jolting" open of the course joints towards the North face slope.

The result of the "jolting" effect described in ¶¶ 187 to 189 is shown clearly by the eccentric position of the top platform, as shown on Plate XXXI. The angle of the South stepped core slope with the horizontal, according to Petrie's survey data, is not sensibly different from the original casing slope—51° 51′ 13″ as against the original 51° 51′ 14″. Owing to the cumulative jolting open of the joints of the courses towards the North face, the angle of the North stepped core slope with the horizontal is now 51° 54′ 24″. This is as described in ¶ 182.

Possible range of criticism regarding the distortion diagram.

Certain minor features of Plate XXXI may be open to discussion and revision. We are confident, however, that, in the main, the data and conclusions upon which the features of Plate XXXI are based, and the general presentation of these features, give a true representation of the facts.

¶ 208. PLATE XXXII. PLAN AND SECTION OF NORTH END OF GRAND GALLERY.

The bridging slab over mouth of passage to Queen's Chamber.

The features illustrated in this Plate are shown in perspective on the right-hand side of the Frontispiece. Both plates show the holes for the beams that originally carried the slab closing the entrance to the horizontal passage leading to the Queen's Chamber. The shallow depth of the slab, and the closeness of the beams for such a shallow slab, show that the slab was merely a temporary bridging contrivance used in course of construction. (Refer also Plates XXXIII and XXXIV.)

Its purpose temporary, for bridging during construction.

The clear evidence that access via 1st Ascending Passage was closed before Queen's Chamber, Grand Gallery, Antechamber, and King's Chamber were built.

Now the depth and width of the granite plugs closing the lower end of the 1st Ascending Passage clearly show that the plugs were built into the passage when the Pyramid masonry had reached the height of the plugs. This is certain from the fact that half an inch of clearance at the sides and top in the 1st Ascending Passage would not be sufficient to ensure the granite plugs being lowered from the Grand Gallery without risk of jamming in the descent of the 1st Ascending Passage. As existing, the depth of the plugs is greater than the depth of the upper end of the 1st Ascending Passage, and equal to the geometrical (original) depth of the Passage. It is clear, then, that the granite plugs were in position before the Pyramid courses had reached the height of the lower end of the Grand Gallery. The purpose of the bridging slab was not, therefore, for temporary bridging access *via* the 1st Ascending Passage.

The bridging slab not therefore for bridging access on entrance route, via 1st Ascending Passage.

Tombic theory applied to the Great Pyramid untenable.

It is obvious, also, that the plugging of the 1st Ascending Passage when the Pyramid courses had reached the height of the plugs precludes the idea that the Great Pyramid was intended as a tomb, unless the king conveniently died when the work had not long been commenced. (Refer Plates XXXV and XXXIX.)

¶ 208a. THE CONSTRUCTIONAL GAUGE RUNGS OF THE GRAND GALLERY.

The clue of the Gallery ramp holes and let-in stones.

A clue to the purpose of the bridging slab is seen in the holes sunk in the ramp stones, exactly opposite each other on both ramps, and in the let-in stones—over each ramp hole except the first two—opposite each other in the walls of the Grand